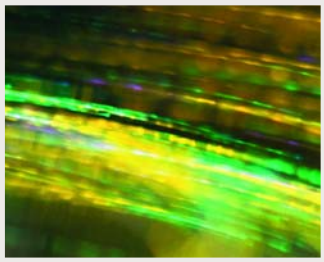
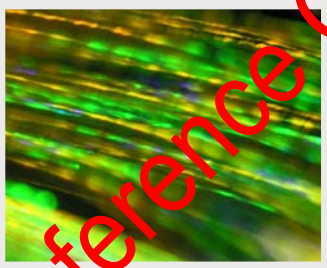
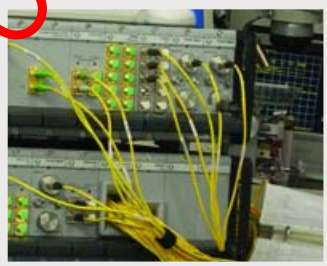
Instrumentation Catalog

2005







Fiberoptic Instrumentation

JDS Uniphase

Our 20 years of industry leadership brings you award-winning, standard-defining test equipment. Whether you test multimode fiber, passive components, or transmission subsystems, JDS Uniphase can help you create the most economical, flexible and high-performance optical test solutions for manufacturing and R&D.

Table of Contents

Finding a Solution

JDS Uniphase is committed to providing you with the strongest possible application support - a commitment that goes beyond the operation of our products. It extends to understanding the specifics of the measurements you are implementing.

We believe in learning from every customer interaction. By combining your measurement experiences with ours and leveraging the flexibility and performance of our products, we can deliver a more powerful solution.

Our goal is to find ways to optimize measurement performance, reduce cycle times and minimize your cost of ownership. Working together, we can create solutions that meet your capital budget and simplify your development, without compromising the performance and the reliability you need to keep your program or factory on track.

Our next generation products are driven by your needs. Throughout our history, we have worked hard to listen to our customers and are eager to explore new ideas and opportunities. They may range from simple product enhancements to new product concepts. We have confidence in our product breadth, but are equally driven to continue to find new ways to add value to your test and measurement applications.

Contact Us

Look for the following note throughout this document. It is your invitation to discuss specific measurement needs with our application and product experts.

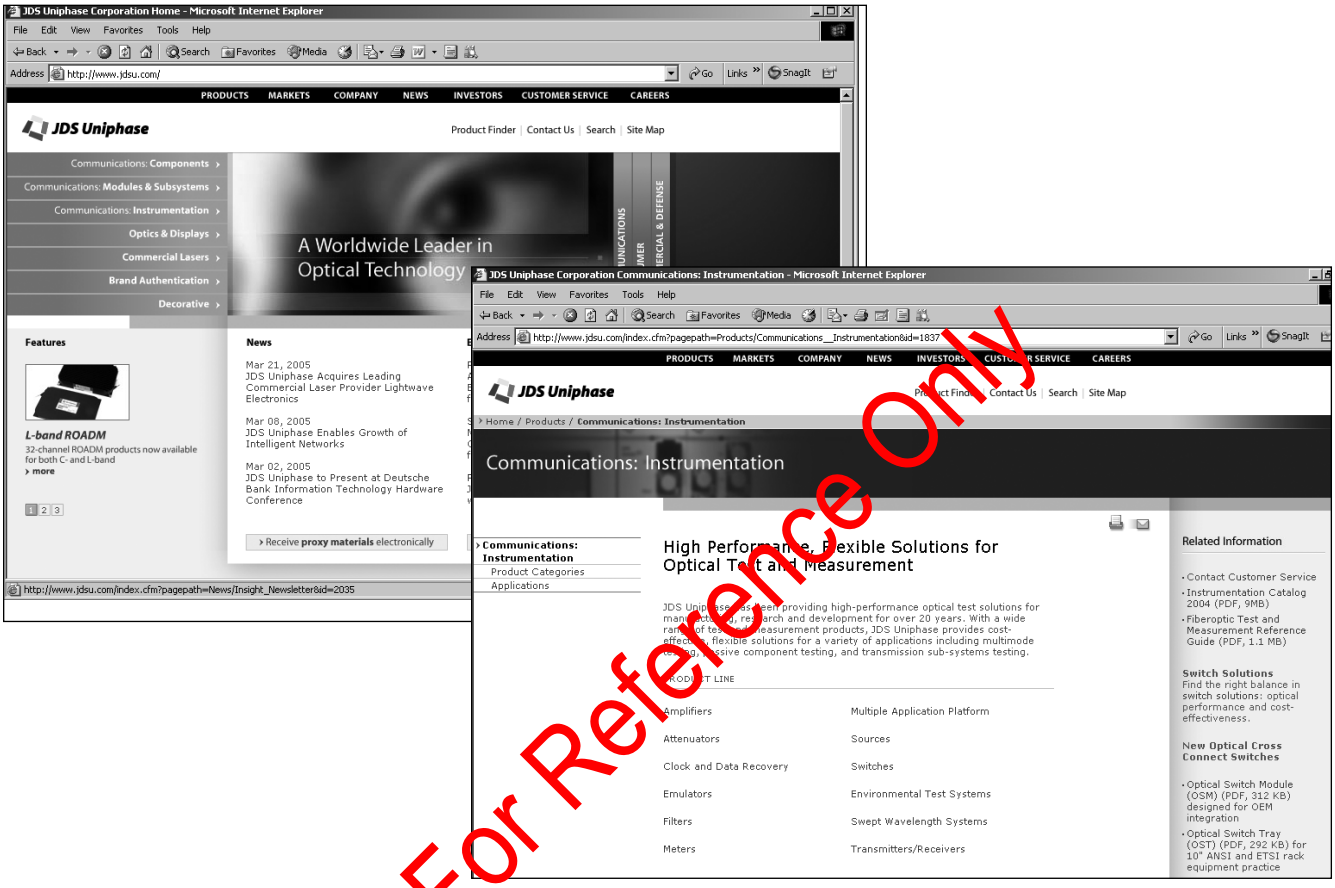
> If the configurations available do not meet your performance requirements, please contact our global sales and customer service team to discuss the potential for specialized solutions.

Request for Information

Help us keep you informed. Obtain additional information about the latest developments in fiberoptics quickly and easily. Sign-up for e-mail or postal delivery of new product updates, application notes, datasheets or additional catalogues at:

instruments@jdsu.com

Finding a Solution



www.jdsu.com/instrumentation

The information you need is at the click of a mouse. Visit our Website for the latest test and measurement developments from JDS Uniphase and for valuable resources including:

- Application Notes
- Datasheets
- Multimode Testing Page
- Drivers and Software Resources (software, firmware, drivers, sample VIs)
- Sales and Customer Support Contact Information
- Access to Technical Experts

Instrumentation Technical Support

NORTH AMERICA

Toll Free: 800 406-9559

Toll Free Fax: 800 898-8537

Tel: 613 843-3000 Ext. 4999

Fax: 613 843-3333

E-mail: support@jdsu.com

OUTSIDE NORTH AMERICA

Toll Free: +800 4069-5599

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China Toll Free: +10 800 140 5599

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Israel	014
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New Zealand	00
Singapore	001
South Korea	001 Korea Telecom, 002 Dacom
Sweden	009 Telia, 007 Tele2
Taiwan	00

*For all other countries, dial the access code for North America.

About Technical Support

JDS Uniphase has a dedicated post-sales support team ready to help you answer any questions or concerns about Instrumentation products.

Standard Technical Support

(Included with every instrumentation product purchase)

Our technical support specialists are available live, via our global toll-free 800 number or via e-mail (8:00 AM - 5:00 PM ET, Monday through Friday).

If you are experiencing a problem with the operation of a product, our Technical Support Specialist is trained to work with you, to carry out technical troubleshooting to resolve or confirm the reported problem. If a problem is confirmed, the Technical Support Specialist will ensure the appropriate action is taken to address your needs.

All service (repair, calibration, upgrade) for our products is provided via the JDS Uniphase Technical Support Team.

Replacement user manuals and any software updates are also included in our standard support package.

24-7 Emergency Technical Support

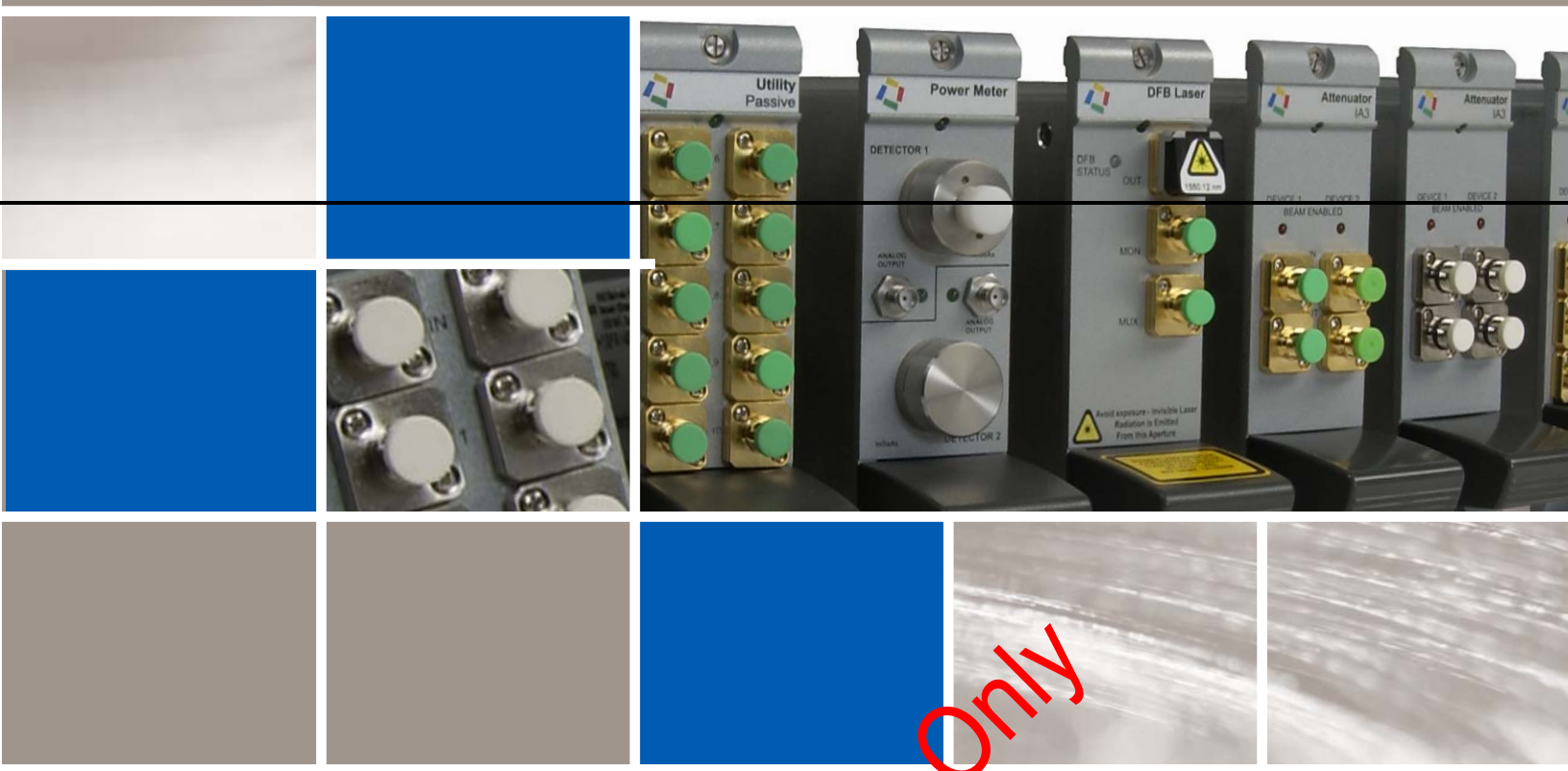
24-7 Emergency Technical Support via our global toll-free 800 number is also included in our standard level of support. If you require emergency technical support, a Technical Support Specialist will be paged, and will return your call promptly.

For further information, including Extended Support Options and Technical Training, please refer to the Accessories and Support Options section.

Contact Support

Regular support hours of operation are 8:00 AM - 5:00 PM ET, Monday through Friday, excluding holidays.

Emergency Technical Support is available 24 hours a day, 7 days a week if your equipment is not functioning and you have an urgent requirement for assistance. Dial one of the telephone numbers and follow the voice prompts to page a specialist.



Multiple Application Platform

JDS Uniphase's Multiple Application Platform (MAP) was designed to help manage the test and measurement needs of an industry that requires flexibility and dynamic performance. Our goal is to offer researchers, designers and manufacturing engineers, a platform that outshines all others with its modularity, reliability and flexibility.

The optical cassette's breadth and performance are consistent with the fiberoptic technology leadership from JDS Uniphase, that for over 20 years, has been committed to meeting your physical layer testing challenges.

The MAP Console software is an out-of-the-box application that provides an intuitive and user-friendly environment to ensure that your test and measurement systems can be integrated quickly and efficiently.

Included in This Section

MAP Selection Guide

MAP Master

A flexible instrumentation platform ideal for optical or the electro-optical test and measurement applications. A 19-inch rackmountable chassis featuring: 8-slot capacity, over 20 hot-swappable instrument cassettes, color display, dynamic MAP firmware and console that automatically identifies installed cassettes, reversibility for front/rear access, ActiveX console and drivers with simulation mode, and expandable capacity to 64 cassettes (by adding up to seven 8-slot slave chassis).

Page 14

MAP Benchtop

Bring the power of MAP to your lab bench!

An economical solution for test sets requiring 3 or fewer instrumentation cassettes. Easily expandable by adding up to seven 8-slot chassis slave configurations supporting up to 59 cassettes.

Page 14

Application Reference Table

The MAP system of products addresses standard testing requirements in addition to evolving testing challenges. See the table below for a sampling of tests and the appropriate measurement equipment. Refer to the Test and Measurement Reference section for a comprehensive guide to test and measurement applications.

	10 Gb/s NETWORK TEST BED	TRANSMITTER DISPERSION PENALTY	EXTINCTION RATIO	EYE MASK	BIT ERROR RATE	OSNR	INTRINSIC JITTER	OPTICAL GAIN	NOISE FIGURE	POLARIZATION DEPENDANT GAIN	INSERTION LOSS	POLARIZATION DEPENDENT LOSS	RETURN LOSS
10 Gb/s Receiver	✓	✓	✓	✓	✓	✓	✓						
10 Gb/s Transmitter	✓		✓	✓	✓	✓	✓						
Clock and Data Recovery	✓	✓		✓	✓	✓	✓						
DFB Laser	✓						✓	✓	✓	✓	✓	✓	✓
Fabry-Perot Laser	✓										✓	✓	✓
Tunable Laser	✓							✓	✓	✓	✓	✓	✓
Broadband Source	✓					✓					✓	✓	✓
Power Meter	✓		✓	✓		✓	✓	✓	✓	✓	✓	✓	✓
Tunable Filter	✓	✓				✓		✓	✓	✓	✓	✓	✓
Switches	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Precision Attenuator	✓	✓		✓	✓	✓		✓	✓	✓			
Attenuator with Power Control	✓	✓		✓	✓	✓		✓	✓	✓			
Variable Backreflector	✓	✓											✓
EDFA	✓	✓				✓		✓	✓				
Polarization Controller	✓	✓				✓			✓	✓		✓	✓
Couplers and Splitters	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
RF Switch	✓	✓		✓	✓		✓						

MAP Selection Guide

MAP EDFA

Available in six configurations: pre-amplifier, booster, booster-high power, mid-span access booster, in-line and booster-DWDM. Features a low noise figure, high output power and high gain. Currently the high power booster model offers an output of 21 dBm.

Page 19

MAP Precision Attenuator with Power Control

A high resolution, wide wavelength range attenuator. Available with 1 or 2 devices per cassette, single-mode or multimode fiber, four standard connector types, and tap option or power control feature.

Page 22

MAP Multi-Rate Electrical Clock and Data Recovery

A cost effective clock and data recovery reference for electrical datastreams at 10 Gb/s rates. The internal clock reference provides five selectable data rates (SONET/SDH std, FEC, 10 Gigabit Ethernet and Fibre Channel).

Page 26

MAP 1550 nm Optical Transmitter

An externally modulated 1550 nm transmitter. The transmitter provides complete control of the bias circuitry and low chirp operation. It also includes the required modulator driver.

Page 28

MAP 850 nm Optical Transmitter

A directly modulated VCSEL-based transmitter. The transmitter provides a cost-effective optical source for 850 nm, 10 Gigabit Ethernet and Fibre Channel applications.

Page 30

MAP 1310 to 1550 nm Optical Receiver

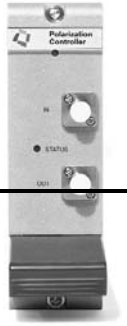
A broadband APD-based receiver from front panel connector. Provides both analog and a digital (limited) output. The limiter threshold can be set automatically or manually.

Page 32

MAP 850 to 1550 nm Optical Receiver

A PIN-based linear receiver which serves as a cost effective optical reference at 10 Gb/s data rates. Ideally suited for 10 Gigabit Ethernet and Fibre Channel applications. Analog and limited differential outputs.

Page 34



MAP Polarization Controller

An efficient and precise polarization controller that can create any state of polarization. May also be used as part of a polarization state analyzer.

Page 36

MAP Selection Guide

MAP Variable Backreflector

Provides precise levels of return loss (RL) to transmitters allowing measurements of system sensitivity or system degradation as a function of backreflection. Available in single-mode or multimode and with an optional coupler for monitoring.

Page 38

MAP Tunable Grating Filter

A tunable bandpass filter that offers continuous wavelength tuning from 1420 to 1630 nm. The standard model has a maximum input power of 300 mW and the high power option provides a maximum input power of 1000 mW.

Page 41

MAP Power Meter

Features accuracy, high linearity and extremely low polarization dependent loss (PDL). Incorporates a standard analog output. Model with 10 mm detector adapter may be used with up to 72 channel multimode ribbon fibers

Page 45

MAP Broadband Source

Offers an amplified spontaneous emission (ASE) output that features flattened high power density across the C-band or C+L-band. The source provides high spectral stability.

Page 49

MAP DFB Laser

May be used to create an ITU grid in which optical frequency represented by a DFB laser corresponds to the transmitter in the optical network. Can be selected to comply with the 50 GHz ITU grid in the C-band and L-band (1527 to 1610 nm) wavelength ranges.

Page 52

MAP DFB Laser - Analog Modulation

Offers 1 GHz of modulation bandwidth from front panel connector. Designed to meet the needs of CATV test. Low distortion ensures accurate CATV receiver test.

Page 56

MAP Fabry-Perot Laser

Designed to produce a stable light source at desired wavelength. Offers optimal stability and features such as built-in internal and external modulation capabilities, and variable power control.

Page 59

MAP LED Source

A high-power Light Emitting Diode (LED)-based light source with variable output power.

Page 62

MAP Selection Guide

MAP Tunable Laser

An external cavity tunable diode laser that offers exceptional speed, accuracy and flexibility at a competitive price.

Page 64

MAP Large Channel Count Switch

A bidirectional switch, allowing the connection of a common port to any number of channels up to 50. Available in single or dual-switch configurations. Exhibits low insertion loss and high return loss.

Page 66

MAP Small Channel Count Switch

A low-cost switch allowing for a number of configurations. The switch is bidirectional, transparent to signal format, and available in both single-mode and multimode versions.

Page 69

MAP RF Switch

A 50 Ohm coaxial switch for routing RF and microwave signals at frequencies up to 26.5 GHz.

Page 73

MAP Utility

Simplifies the mechanical integration of passive optical components for test sets. Highly configurable, contains passive optical devices such as splitters and taps. Supports angle or flat polish connectors as well as single-mode and multimode fibers.

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Multiple Application Platform

MAP Series

MAP Master and Slave Chassis

MAP Benchtop and Slave Chassis

Key Features

- Hot-swappable cassettes (cassettes can be inserted or removed without powering down)
- Master/slave configuration so that a single controller can control up to eight chassis
- Dynamic MAP firmware and console that automatically identifies installed cassettes
- PC-based MAP Console program with drivers, ActiveX, Dynamic link libraries (DLL), LabVIEW and simulation mode
- Color display
- RS-232 and GPIB interface

Applications

- Periodic reconfiguration and/or expansion capability
- High reliability/availability in a 24/7 manufacturing environment

Safety Information

Optical source cassettes, when installed in the MAP chassis, meet the requirements of standard IEC 60825-1(2002) and comply with 21 CFR 1040.10 except deviations per Laser Notice No. 50, July 2001.

CE Compliance plus UL3101-1 and CAN/CSA-C22.2 No. 1010.1

The Multiple Application Platform (MAP) is a flexible instrumentation platform used for optical or electro-optical test and measurement applications. It is available in three formats: a 19-inch 8-slot Master (MAP+2M00), a 19-inch 8-slot Slave (MAP+2S00) and a 9.5-inch 3-slot Benchtop (MAP+2B00). They feature a common hot-swappable backplane compatible with over 20 different types of instrumentation cassettes.

The MAP Master and MAP Benchtop include a 9-key keypad, color display, remote communication ports and connectors for inter-chassis connections. They can be used as stand-alone system or as a master when used in a master-slave configuration with up to seven MAP Slaves.

Chassis Selection

MAP is used when instrumentation selection needs to be based on current requirements without compromising future requirements. The MAP+2B00 and MAP+2M00 provide the most cost-effective solutions for test sets requiring three or fewer cassettes and four to eight cassettes respectively. In both cases, future expansions are possible by populating the empty slots (if available), adding a second independent MAP+2B00 or MAP+2M00 or adding a MAP+2S00 as a slave. The three chassis formats provide an endless number of configurations and numerous expansion paths.

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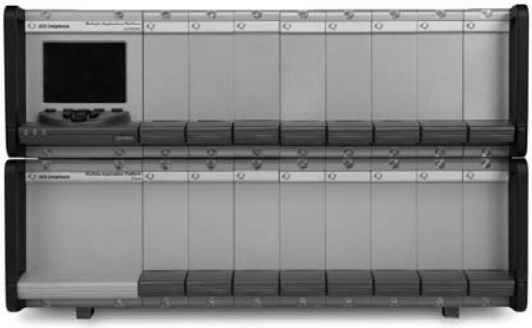


MAP Master (MAP+2M00) and Slave (MAP+2S00)

The MAP Master and MAP Slave are built on a fully modular architecture. The main controller module, power supply module, keypad/display module and remote interface module are all field replaceable, thus making maintenance fast and simple. The keypad/display module and remote interface module of the MAP Master and Slave are interchangeable for rear mounting. Handling and rackmounting are made easy by using the practical handles located at the front and back of each chassis. When used on a bench, the tilting feet hold the chassis at an optimal angle for monitor visibility and keypad accessibility.

Key Features

- Front or back fiber connection
- 8-slot capacity
- All modules are field replaceable:
  - controller
  - power supply
  - keypad/display
  - remote interface

MAP Benchtop (MAP+2B00)

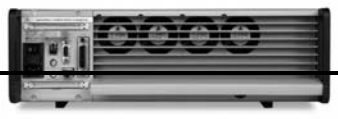
The MAP Benchtop brings the MAP products to your lab bench without compromising performance. Its form factor and lower cost make it ideal for small test-sets. When test needs growth, the application can be expanded with MAP Benchtop in a master/slave configuration or transferred to an eight-slot MAP Master. Software applications, developed for the MAP Benchtop, can be transferred to a MAP Master without any modifications.

Key Features

- Compatible with the MAP Slave
- 3-slot capacity

Connectors Accessible at Front

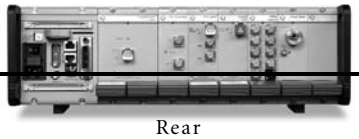
Front



Rear

Connectors Accessible at Rear

Front



Rear

MAP Master Reconfigurability

NORTH AMERICA: 800 498-JDSU (5378) | WORLDWIDE: +800 5378-JDSU | WEBSITE: www.jdsu.com

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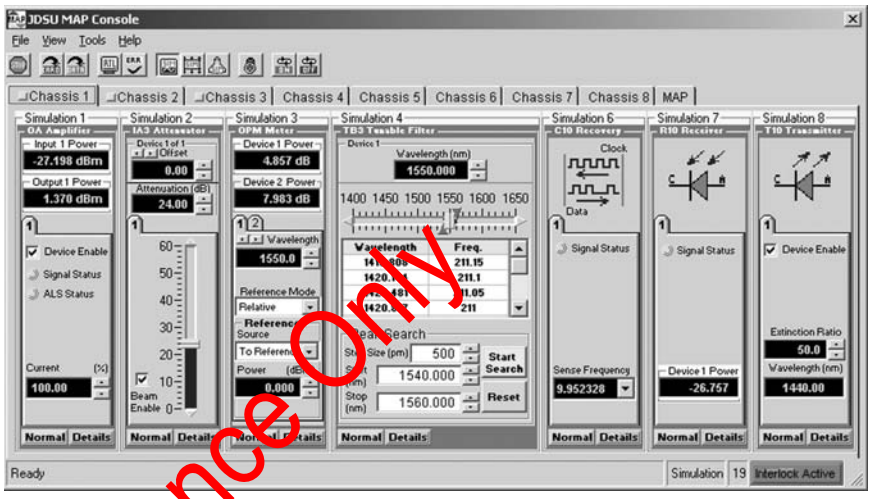

View of MAP Console Program

Software

Intuitive MAP Console and Drivers

MAP is supplied with comprehensive PC-based instrument drivers and MAP Console for added functionality. Drivers supplied include ActiveX, DLL, and LabVIEW. These provide full control of the cassettes and are compatible with all the standard Automation Development Environments (ADEs) including LabVIEW, Visual Basic™, and TestPoint™. These drivers provide drop-in instrument programming capabilities, allowing test programmers to focus on test level functions and sequences rather than the details required to communicate with the specific cassettes in the MAP system. During test execution, the MAP Console can also be placed in a supervisory mode and used to monitor and control the MAP platform to help support troubleshooting and to minimize downtime. The MAP Console comes with a built-in simulator allowing Automation Developers to capture system configurations who do most of their development off-line, freeing real hardware for other purposes. These features make test automation development and debugging fast and easy.

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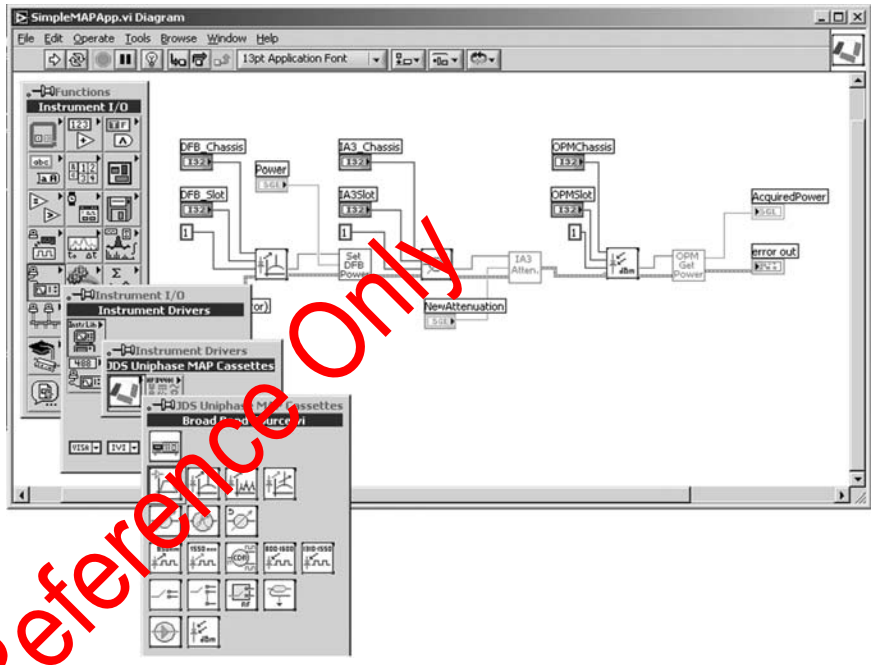


Typical LabVIEW Implementation of the ActiveX Drivers

Specifications

Parameter	MAP Master	MAP Slave	MAP Benchtop
Capacity	8 single-slot cassettes/chassis		3 single-slot cassettes/chassis
Power	100 to 125 V AC/ 200 to 240 V AC, 50/60 Hz Field-replaceable		100 to 125 V AC 200 to 240 V AC, 50/60 Hz
Power consumption	200 V A	200 V A	200 V A
Mounting	Rackmount Benchtop (front, center, or rear)		Rackmount Benchtop (front)
Rackmount kit	Included		Optional (MAP+2A10)
Display LCD color	VGA	No display	VGA
Display dimensions (H x W)	7 x 5 cm	N/A	7 x 5 cm
Resolution	640 x 234 pixels	N/A	640 x 234 pixels
Remote interface	RS-232, GPIB	N/A	RS-232, GPIB
Slot expansion	Controls up to 7 slave chassis	N/A	Controls up to 7 slave chassis
External keyboard	N/A		USB Keyboard
Video output	N/A		VGA
Video input	N/A		BNC Connector (NTSC)
VGA output	N/A		15-pin D-sub connector
Safety interlock	Fail-safe hardware-controlled		
Operating temperature	0 to 50 °C		
Storage temperature	- 30 to 60 °C		
Humidity	< 80% RH, 0 to 40 °C non-condensing		
Dimensions (W x H x D)	44.91 x 13.24 x 52.37 cm (3U high, standard 19-inch width)	44.91 x 13.24 x 52.37 cm (3U high, standard 19-inch width)	22.5 x 14.8 x 43.0 cm (3U high, standard 19-inch width)
Weight	14.3 kg	13.0 kg	8.6 kg

Ordering Information

For more information on this or other products and their availability, please contact your local JDS Uniphase account manager or JDS Uniphase directly at 1-800-498-JDSU (5378) in North America and +800-5378-JDSU worldwide or via e-mail at sales@jdsu.com.

MAP Master Chassis (MAP+2M00)

MAP+2A01	MAP 19-inch Chassis
MAP+2A02	MAP Power Supply Module
MAP+2M01	MAP Master Main Control Module
MAP+2M02	MAP Master Local Interface Module
MAP+2M03	MAP Master Remote Interface Module
MAP+2A03	MAP Rackmount Kit
MAP+2A06	MAP Cassette Blanking Plates (8)
MAP+2A04	MAP Safety Interlock Key
MAP+2A09	MAP Software and Documentation CD
10108925	MAP User's Manual
21057090	MAP Programming Guide

MAP Slave Chassis (MAP+2S00)

MAP+2A01	MAP 19-inch Chassis
MAP+2A02	MAP Power Supply
MAP+2S01	MAP Slave Main Control Module
MAP+2S02	MAP Slave Local Interface Module
MAP+2S03	MAP Slave Remote Interface Module
MAP+2A03	MAP Rackmount Kit
MAP+2A06	MAP Cassette Blanking Plates (8)
MAP+2A07	MAP 8-inch Interconnect Harness
MAP+2A09	MAP Software and Documentation CD
10108925	MAP User's Manual
21057090	MAP Programming Guide

An optional 36-inch Interconnect Harness (part number MAP+2A08) is also available.

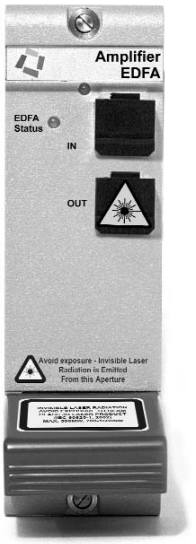
MAP Benchtop (MAP+2B00)

MAP+2A04	MAP Safety Interlock Key
MAP+2A06	MAP Cassette Blanking Plates (3)
MAP+2A09	MAP Software and Documentation CD
10108925	MAP User's Manual
21057090	MAP Programming Guide

An optional 19-inch rackmount kit (part number MAP+2A10) is available to mount one or two units in a 19-inch rack.

MAP Erbium-Doped Fiber Amplifier

EDFA Series



For stand-alone applications, the MAP EDFA may be used as a benchtop

Key Features

- High output power and gain
- Low noise figure
- Monitoring and alarms

Applications

- In-line, pre-amp and booster amplifier emulation
- Dense wavelength division multiplexing (DWDM) transmission for multi-channel applications
- SONET/SDH systems for single channel applications
- Optical signal to noise ratio (OSNR) experiments

Safety Information

This optical source cassette, when installed in the MAP chassis, complies to CE requirements plus UL3101-1 and CAN/CSA-C22.2 No.1010.1, meets the requirements of Class 3B in standard IEC 60825-1(2002), and complies with 21 CFR 1040.1 except deviations per Laser Notice No.50, July 2001.

INVISIBLE LASER RADIATION
AVOID EXPOSURE TO BEAM
CLASS 3B LASER PRODUCT
(IEC 60825-1, 2002)
MAX. 500 mw, 700-1680 nm

The Multiple Application Platform (MAP) Erbium-Doped Fiber Amplifier (EDFA) Cassette combines the optical performance of the traditional JDS Uniphase EDFA benchtop models, with the flexibility and modularity of the MAP. Nine standard configurations are available to meet your needs. The MAP EDFA has a saturated output power ranging from 14 dBm to 21 dBm, features noise figures as low as 3.3 dB and has gain flatness better than 1.4 dB. The MAP EDFA's are available for operation in the C- or L-band.

The MAP EDFA models provide specialized variants and optical performance not available in the Benchtop EDFA line. Additional EDFA models are available in the Benchtop EDFA product line for applications requiring higher saturated power or operation in the C+L-band.

Specifications

Parameter	1546	1550	1552		1554	1558	1590	1592	1594
Amplifier type	Mid-span access booster DWDM	Pre-amp	Booster	Booster high power	In-line	Booster DWDM	Pre-amp	Booster	In-line
Operating wavelength range	1540 to 1560 nm	1528 to 1565 nm	1528 to 1565 nm	1528 to 1565 nm	1528 to 1565 nm	1528 to 1563 nm	1565 to 1610 nm	1565 to 1610 nm	1565 to 1610 nm
Input signal	Multichannel (DWDM)	Single channel	Single channel	Single channel	Single channel	Multichannel (DWDM)	Single Channel	Single Channel	Single Channel
Saturated output power (minimum)[1]	≥ 17 dBm	≥ 14 dBm	≥ 17 dBm	≥ 20 dBm	≥ 17 dBm	≥ 21 dBm	≥ 15 dBm	≥ 15 dBm	≥ 20 dBm
Noise figure (maximum)[2]	≤ 5.5 dB	≤ 3.3 dB	≤ 4.5 dB	≤ 5.0 dB	≤ 3.8 dB	≤ 5.5 dB	≤ 5.0 dB	≤ 5.5 dB	≤ 5.5 dB
Small signal gain (minimum)[3]	≥ 23 dB (MS loss ≤ 10 dB)	≥ 37 dB	≥ 30 dB	≥ 32 dB	≥ 35 dB	≥ 25 dB	≥ 24 dB	≥ 22 dB	≥ 28 dB
Input/output monitors	Yes	No	Yes	Yes	No	Yes	No	Yes	Yes
Polarization dependent loss (PDL) (maximum)	≤ 0.3 dB	≤ 0.2 dB	≤ 0.2 dB	≤ 0.2 dB	≤ 0.2 dB	≤ 0.25 dB	≤ 0.3 dB	≤ 0.3 dB	≤ 0.3 dB
Polarization mode dispersion (PMD) (maximum)	≤ 0.6 ps	≤ 0.5 ps	≤ 0.4 ps	≤ 0.4 ps	≤ 0.5 ps	≤ 0.65 ps	≤ 0.6 ps	≤ 0.6 ps	≤ 0.6 ps
Input/output isolation (typical)	32/32 dB	N/A/32 dB	45/32 dB	45/32 dB	32/32 dB	32/32 dB	N/A/40 dB	40/40 dB	40/40 dB
Spectral gain flatness (maximum) (p-p)[4]	≤ 1.6 dB	N/A	N/A	N/A	N/A	≤ 1.4 dB	N/A	N/A	N/A
Operating temperature	0 to 40 °C								
Storage temperature	- 30 to 60 °C								
Humidity	Maximum 95% RH non-condensing from 0 to 45 °C								
Dimensions (W x H x D)	4.06 x 13.24 x 39.5 cm								
Weight	2.3 kg								

All specifications guaranteed at 1550 nm and at 23 °C.

1. Saturated Output Power measured:
   - at 1550 nm at P_{in} = - 4 dBm
   - at 1550 nm at P_{in} = - 6 dBm for model 1546
   - at 1550 nm at P_{in} = - 4 dBm (mid-span) for models 1550, 1552, 1554, 1558
   - at 1590 nm at P_{in} = - 4 dBm (mid-span) for models 1590 , 1592, 1594
2. Noise figure measured:
   - at P_{in} = - 6 dBm (pre-amp) for model 1546
   - at P_{in} = - 30 dBm for model 1550
   - at P_{in} = - 4 dBm for models 1552,1558,1592
   - at P_{in} = - 20 dBm for models 1554, 1590, 1594
3. Small signal gain measured:
   - at Pin = - 6 dBm for model 1546
   - at P_{in} = - 30 dBm for model 1550
   - at P_{in} = - 20 dBm for model 1552,1554,1590,1592,1594
   - at P_{in} = - 4 dBm for model 1558
4. Flatness optimized:
   - for Pin = - 4 dBm for model 1558
   - for P_{in} = - 6 dB for model 1546

Ordering Information

For more information on this or other products and their availability, please contact your local JDS Uniphase account manager or JDS Uniphase directly at 1-800-498-JDSU (5378) in North America and +800-5378-JDSU worldwide or via e-mail at sales@jdsu.com.

Sample: MAPO+1E15520FP20

MAPO+1E □□□□ □ □□ □ **0**

Code	Description
1546	Mid-span access booster
1550	C-Band Pre-amp
1552	C-Band Booster
1554	C-Band In-line
1558	Booster DWDM
1590	L-Band Pre-amp
1592	L-Band Booster
1594	L-Band In-line

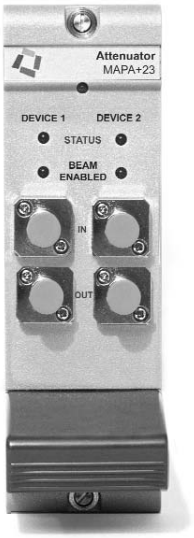
Code	Connector Type
FP	FC/PC
FA	FC/APC

Code	Characteristics
0	Unflattened
2	Flattened (1546 and 1558 only)

Code	Output Power
0	Standard output power
2	Booster high output power, 20 dBm (available for 1552 only)

Code	Characteristics
0	Standard

MAP Precision Attenuator



For stand-alone applications, the MAP Precision Attenuator may be used as a benchtop

Key Features

- Low insertion loss (IL) ≤ 1.5 dB
- Low polarization dependent loss (PDL) 0.05 dB
- Wide wavelength range
- High return loss (RL) ≥ 60 dB

Applications

- Dense wavelength division multiplexing (DWDM) channel equalization (up to 128 channel/controller address)
- Amplifier characterization
- Bit error rate (BER) testing
- Precise optical power control (± 0.01 dB)
- Loss simulation in DWDM fiber links
- Receiver and transmitter testing

Safety Information

This cassette, when installed in a MAP chassis, complies to CE requirements plus UL3101-1 and CAN/CSA-C22.2 No. 1010.1.

The Multiple Application Platform (MAP) Precision Attenuator is a high resolution, wide wavelength range attenuator used in applications such as analog systems and high bit-rate digital systems. The attenuator is built on proven industry leading technology for maximum reliability and performance.

Many configurations are available: single or dual device per single width cassette, single-mode (SM) or multimode (MM) fiber, four standard connector types, and tap option or in-line power monitor feature. The power control option can function as an in-line power monitor.

Continued

Application: Controlling Output Power

One of the primary applications of an attenuator is to create a precise signal of known output power. With the MAP Precision Attenuator, three options are possible:

- A standard attenuator. To control output power, measurement of the input power is required prior to testing. Output power is externally calculated based on the set attenuation. Figure (a) shows a standard attenuator.
- A standard output tap. Calibration of the output power is achieved through use of an external power meter and calibration of the tap path loss. Adjustments for changes in input power require external adjustments of the attenuator. Figure (b) shows the implementation of the standard output tap.
- An internal in-line power monitor. Output powers can be set directly with internal calibration and monitoring compensating for input power and path losses. In addition, the unit may be set into a closed-loop mode where output power is dynamically controlled. Figure (c) shows the internal in-line power monitor.

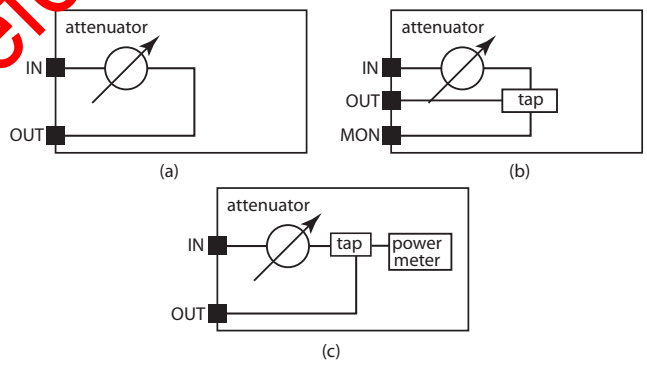


Figure 1: Optical configuration of the attenuator cassette.
(a) without options
(b) with tap option
(c) with in-line power monitor option

Specifications

Parameter	Single-mode fiber (SMF) without Power Monitor	Single-mode fiber (SMF) with Power Monitor	Multimode fiber (MMF) without Power Monitor	Multimode fiber (MMF) with Power Monitor
Wavelength range	1260 to 1650 nm		750 to 1350 nm	
Insertion loss (IL)[1, 2, 3] at minimum attenuation	≤ 1.5 dB[4]	≤ 2.2 dB	≤ 2.2 dB[4]	≤ 3.2 dB
Attenuation range	60 dB		45 dB	
Attenuation repeatability[3,5]	± 0.01 dB		0.01 dB	
Attenuation accuracy[3,6]	± 0.1 dB		± 0.1 dB	
Attenuation slew rate (nominal)	>10 dB/s typical		> 7 dB/s typical	
Attenuation setting resolution	0.001 dB		0.001 dB	
Maximum input power	23 dBm		23 dBm	
Polarization dependent loss (PDL)[3, 7]	≤ 0.05 dB[4]	≤ 0.15 dB[4]	N/A	
Return loss (RL) (APC and PC connector)[4,8]	> 60/45 dB		> 35/30 dB	
Closed-loop output power range (in-line power monitor option)	N/A	- 29 to 11 dBm at 1310/1550 ± 15 nm	N/A	- 40 to 5 dBm at 850/1310 ± 15 nm
Relative power meter uncertainty[3,5,9,10]	N/A	± 0.03 dB	N/A	± 0.03 dB
Power setting repeatability[5,9]	N/A	± 0.015 dB	N/A	± 0.015 dB
Power setting resolution	N/A	0.001 dBm	N/A	0.001 dBm
Shutter isolation	> 100 dB			
Calibration period	2 years			
Warm-up time	30 minutes			
Operating temperature	0 to 50 °C			
Storage temperature	- 30 to 60 °C			
Operating humidity	< 90 % at 23°C, < 20 % at 50 °C (relative, non-condensing)			
Dimensions (W x H x D)	4.06 x 13.24 x 39.5 cm			
Weight	1.1 kg (single)/1.3 kg (dual)			

1. At 1310 ± 15 and 1550 ± 15 nm for SM unit and at 850 ± 15 and 1310 ± 15 for MM unit.
2. Including one mated pair of connectors.
3. At 23 ± 5 °C.
4. Not including tap coupler loss, if installed.
5. Constant wavelength, constant temperature, constant state of polarization.
6. Maximum specification at 1310 ± 15 and 1550 ± 15 nm for SM unit and at 850 ± 15 and 1310 ± 15 for MM unit.
   Outside these wavelength ranges, the typical accuracy is the greater of ± 0.1 dB or ± 0.003 dB/dB.
7. At 1310 ± 15 and 1550 ± 15 nm.
8. At 1550 ± 15 nm for SMF and 1310 ± 15 for MMF.
9. Over output power range.
10. Add 0.01 dB/dBm for output power below - 45 dBm at 1310 and 1550 nm and output power below - 40 dBm at 850 nm.

Ordering Information

For more information on this or other products and their availability, please contact your local JDS Uniphase account manager or JDS Uniphase directly at 1-800-498-JDSU (5378) in North America and +800-5378-JDSU worldwide or via e-mail at sales@jdsu.com.

Sample: MAPA+2319101FA

MAPA+23 □□ □ □ □ □□

Code	Fiber Type (µm)
19	50/125, 750 to 1350 nm
29	62.5/125, 750 to 1350 nm
70	9/125, 1200 to 1700 nm

Code	Cassette Type
1	Single attenuator
2	Dual attenuator (identical)

Code	Built-in Options
0	None
1	50/50 coupler
9	10/90 coupler
X	In-line power monitor

Code	Port Type
0	Bulkheads
1	3 mm pigtails (2 m long)

Code	Connector Type (all ports)
FP	FC/PC
FA	FC/APC
SC	SC/PC
SU	SC/APC

If the configurations available do not meet your performance requirements, please contact our global sales and customer service team to discuss the potential for specialized solutions.

MAP Multi-Rate Electrical Clock and Data Recovery

For stand-alone applications, the MAP Clock and Data Recovery may be used as a benchtop

Key Features

- Five key 10 Gb/s rates supported
- Single-ended or Differential Data Input
- Clock and data recovery
- Clock/4 output for scope triggering

Applications

- Receiver component testing
- Sampling oscilloscope trigger generation
- System testing

Safety Information

This cassette, when installed in a MAP chassis, complies to CE requirements plus UL3101-1 and CAN/CSA-C22.2 No. 1010.1.

The Multiple Application Platform (MAP) Multi-Rate Electrical Clock and Data Recovery Cassette provides a cost effective clock and data recovery reference for electrical datastreams at 10 Gb/s rates.

The internal clock reference provides five selectable data rates: SONET/SDH std, two forward error corrections (FECs), a 10-Gb Ethernet and a fiber channel.

A low jitter Clock/4 output is ideally suited to provide a trigger signal for a sampling scope. Combine this MAP cassette with the MAP Receiver Cassette to form a complete optical clock recovery solution. Add a MAP Transmitter Cassette to form a sensitive regenerator for laboratory applications.

Specifications

Parameter	Minimum	Typical	Maximum
Data rates, NRZ coding, balanced transition density		9.95328 Gb/s, 10.3125 Gb/s, 10.51875 Gb/s, 10.66423 Gb/s, 10.70923 Gb/s	
Data frequency tolerance			
9.953, 10.664, 10.709 Gb/s rates			± 40 ppm
10.3125 and 10.51875 Gb/s rates			± 120 ppm
Data input		Electrical, single-ended or differential[1]	
Data input impedance, single-ended		50 Ohms	
Data input-single ended amplitude AC coupled		10 mV p-p	1 V p-p
Output impedance, single-ended for data, clock, and clock/4 outputs		50 Ohms	
Data output amplitude: AC coupled, non-inverting	500 mV p-p		
Clock output amplitude: AC coupled	300 mV p-p		
Clock output intrinsic jitter (wideband): source jitter excluded, PRBS 2^{31}-1			0.03 UI RMS
Clock output jitter transfer bandwidth[2]			5 MHz
Clock/4 output amplitude: AC coupled		500 mV p-p	
Clock/4 output squelched			20 mV
Clock/4 output intrinsic jitter: typical, source jitter excluded, PRBS 2^{31}-1			0.02 UI RMS
Clock/4 output jitter transfer bandwidth[2]			80 kHz
Data and clock BER: data 10 mV p-p, NRZ, PRBS 2^{31}-1			10^{-12}
Electrical connectors		SMA	
Operating temperature		0 to 50 °C	
Storage temperature		- 30 to 60 °C	
Dimensions (W x H x D)		4.06 x 13.24 x 39.5 cm	
Weight		1.8 kg	

1. Maximum differential input skew, 10 ps.
2. By design.

Ordering Information

For more information on this or other products and their availability, please contact your local JDS Uniphase account manager or JDS Uniphase directly at 1-800-498-JDSU (5378) in North America and +800-5378-JDSU worldwide or via e-mail at sales@jdsu.com.

Please use the part number below to order the MAP Multi-Rate Electrical Clock and Data Recovery.

MAPC+110E0NSM

MAP 1550 nm Optical Transmitter

For stand-alone applications, the MAP 1550 nm Optical Transmitter may be used as a benchtop

Key Features

- Complete transmitter solution
- High output power
- Wide frequency range
- Polarization maintaining fiber (PMF) output
- Operational from 155 Mb/s to 12.5 Gb/s data rates

Applications

- Receiver testing
- Sensitivity characterization
- Load generation
- Bit error rate (BER) testing
- System testing

Safety Information

This optical source cassette, when installed in the MAP chassis, complies to CE requirements plus UL3101-1 and CAN/CSA-C22.2 No.1010.1, meets the requirements of Class 3B in standard IEC 60825-1(2002), and complies with 21 CFR 1040.1 except deviations per Laser Notice No.50, July 2001.

INVISIBLE LASER RADIATION
AVOID EXPOSURE TO BEAM
CLASS 3B LASER PRODUCT
(IEC 60825-1, 2002)
MAX. 500 mw, 700-1680 nm

The Multiple Application Platform (MAP) 1550 nm Optical Transmitter Cassette is an externally modulated 1550 nm transmitter. The transmitter provides complete control of the bias circuitry and low chirp operation. It also includes the required modulator driver.

The transmitter can be used for applications such as testing of receivers and transceivers. By combining the transmitter with other MAP cassettes (including switches and attenuators), compact test facilities can be easily assembled.)

The radio frequency (RF) input path includes an automatic gain controller (AGC) amplifier, making the optical output waveform extinction ratio independent of input drive level over its specified range.

Specifications

Parameter	Minimum	Typical	Maximum
Optical wavelength	1530 nm	1550 nm	1565 nm
Optical output power Pseudo-random binary sequence (PRBS) 2^{31}-1, average modulated power	- 0.4 dBm	0.2 dBm	1.4 dBm
Optical power (laser off)		- 50 dBm	
Extinction ratio	9.5 dB	11.0 dB	
Eye mask margin		15 % using OC 192 mask at 9.95328 Gb/s with 4th order B.T. filter applied	
Wideband jitter at 10.71 Gb/s, PRBS 2^{31}-1, excluding source jitter		2.1 ps RMS	5.0 ps RMS
Optical path penalty at 10-12 bit error rate (BER), 800 ps/nm at 1550 nm			2.0 dB
General			
Data rate[1]	0.622 Gb/s		10.71 Gb/s
Optical connector	FC/PC, SC/PC		
Optical fiber		10.5/125/400 um, polarization maintaining	
Electrical connector		SMA	
Data input amplitude range[2]	0.5 V p-p		1.2 V p-p
Data input coupling		AC-coupled	
Impedance		50 Ohms	
Polarity		Non-inverting digital input high = Optical high	
Return loss (RL)			
75 to 5000 MHz		12 dB	
5000 to 9000 MHz		9 dB	
Operating temperature		0 to 50 °C	
Storage temperature		- 30 to 60 °C	
Dimensions (W x H x D)		4.06 x 13.24 x 39.5 cm	
Weight		1.2 kg	

1. Guaranteed performance.
2. Limiting pre-amplifier prior to modulation driver.

Ordering Information

For more information on this or other products and their availability, please contact your local JDS Uniphase account manager or JDS Uniphase directly at 1-800-498-JDSU (5378) in North America and +800-5378-JDSU worldwide or via e-mail at sales@jdsu.com.

Please use the part number below to order the MAP 1550 nm Optical Transmitter.

MAPT+110O14FP

MAP 850 nm Optical Transmitter

For stand-alone applications, the MAP 850 nm Optical Transmitter may be used as a benchtop

Key Features

- 9.95328, 10.3125 and 10.51875 Gb/s data rates
- Operational from 155 Mb/s to 10.51875 Gb/s data rates
- Adjustable extinction ratio
- 850 nm 10GBASE-SR/W supported

Applications

- Research and development (R&D) testing for 10 Gb/s Ethernet and Fibre Channel
- Receiver components testing
- Dispersion penalty testing
- Sensitivity characterization
- Manufacturing test set
- System testing

Safety Information

This optical source cassette, when installed in the MAP chassis, complies to CE requirements plus UL3101-1 and CAN/CSA-C22.2 No.1010.1, meets the requirements of Class 3B in standard IEC 60825-1(2002), and complies with 21 CFR 1040.1 except deviations per Laser Notice No.50, July 2001.

INVISIBLE LASER RADIATION
AVOID EXPOSURE TO BEAM
CLASS 3B LASER PRODUCT
(IEC 60825-1, 2002)
MAX. 500 mw, 700-1680 nm

The Multiple Application Platform (MAP) 850 nm Optical Transmitter Cassette is a directly modulated Vertical Cavity Surface Emitting Laser (VCSEL)-based transmitter. The transmitter provides a cost effective optical source for 850 nm 10 Gb Ethernet and Fiber Channel applications.

The radio frequency (RF) input path includes an automatic gain controller (AGC) amplifier, making the optical output waveform extinction ratio independent of input drive level over its specified range.

All features are accessible from the MAP Local Interface Controller or remotely for manufacturing test set applications.

Specifications

Parameter	Minimum	Typical	Maximum
Optical performance			
Optical wavelength	840 nm	850 nm	860 nm
Optical output power	- 4.0 dBm		0.5 dBm
Optical power (laser OFF)			- 30 dBm
Extinction ratio at 10.3125 Gb/s Pseudo-random binary sequence PRBS 2^{31}-1 bit stream		3 dB	
Eye mask margin		15 % using IEEE Std. 802.3ae™ - 2002 Eye Mask definition, PRBS 2^{31}- 1, 1000 samples	
Jitter			0.2 UI p-p
General			
Data rates[1]		9.95328, 10.3125, 10.51875 Gb/s	
Data patterns		PRBS 2^{31}-1, 2^{7}-1, $A_nA_iA_nA_i$, $B_nB_iB_nB_i$, (11110000)	
Optical connector		FC/PC, SC/PC	
Optical fiber		Multimode (MM) 50 µm core	
Data input amplitude range	500 mV		1000 mV
Data input coupling		AC coupled to 50 Ohms	
Polarity non-inverting		Digital input high = Optical high	
Operating temperature		0 to 50 °C	
Storage temperature		- 30 to 60 °C	
Dimensions (W x H x D)		4.06 x 13.24 x 39.5 cm	
Weight		1.8 kg	

1. Specifications guaranteed at these data rates ± 100 ppm.

Ordering Information

For more information on this or other products and their availability, please contact your local JDS Uniphase account manager or JDS Uniphase directly at 1-800-498-JDSU (5378) in North America and +800-5378-JDSU worldwide or via e-mail at sales@jdsu.com.

Please use the part number below to order the MAP 850 nm Optical Transmitter.

MAPT+110O31FP

MAP 1310 to 1550 nm Optical Receiver

For stand-alone applications, the MAP 1310 to 1550 nm Optical Receiver may be used as a benchtop

Key Features

- Broad wavelength range
- Wide frequency range
- Analog and digital output
- Adjustable limiter threshold level
- Operational from 155 Mb/s to 12.5 Gb/s data rates
- Optical power monitoring

Applications

- Transmitter testing
- Bit error rate (BER) testing
- System testing

Safety Information

This cassette, when installed in a MAP chassis, complies to CE requirements plus UL3101-1 and CAN/CSA-C22.2 No. 1010.1.

The Multiple Application Platform (MAP) 1310 to 1550 nm Optical Receiver Cassette is a broadband avalanche photodiode (APD)-based receiver. The receiver provides both an analog output and a digital (limited) output. The limiter threshold can be set automatically or manually. In addition, the unit contains an optical power monitor.

The receiver can be used for applications such as testing of transmitters and transceivers. By combining the receiver with other MAP cassettes (including switches and attenuators), compact test facilities can be easily assembled.

The analog output is provided via an automatic gain controller (AGC). Therefore, the output is limited but not squared. The analog output will be linearly related to the input; however, the gain will change depending on the amplitude. The digital outputs are limited.

Specifications

Parameter	Minimum	Typical	Maximum
Optical performance			
Optical wavelength - operational range	1290 nm		1565 nm
Input optical return loss (RL)	27.0 dB		
Overload at 10.709255 and 9.953280 Gb/s[1]	- 7.0 dBm	- 6.0 dBm	
Sensitivity[1]			
10.709255 Gb/s		- 21.5 dBm	- 16.5 dBm
9.953280 Gb/s		- 23.5 dBm	- 18.5 dBm
Optical power monitoring accuracy[2]	- 1.0 dB	0.5 dB	+ 1.0 dB
Absolute maximum optical input level			+ 3 dBm
LOS factory preset threshold	- 28.5 dBm	- 29.5 dBm	- 31.0 dBm
Electrical performance			
Output amplitude, analog[3]	0.15 V p-p	0.20 V p-p	
Output amplitude, digital[4]	0.40 V p-p	0.45 V p-p	1.30 V p-p
Output coupling		AC-coupled	
Impedance		50 Ohms	
General			
Data rates[5]	155.52 Mb/s		10.71 Gb/s
Optical connector		FC/PC	
Optical fiber		9/125/900 µm single-mode (SM)	
Output connector		SMA female	
Operating temperature		0 to 50 °C	
Storage temperature		- 30 to 60 °C	
Dimensions (W x H x D)		4.06 x 13.24 x 39.5 cm	
Weight		1.8 kg	

1. For 1310, 1550 nm at a bit error rate (BER) of 10-12.
2. Over the power monitoring range, - 25 dBm to - 3 dBm, and over the operating temperature range.
3. Optical input power = - 13 dBm, wavelength = 1550 nm.
4. Positive and negative outputs are limited. Cable lengths are controlled, not matched and phase difference may vary by 50 ps.
5. Guaranteed performance.

Ordering Information

For more information on this or other products and their availability, please contact your local JDS Uniphase account manager or JDS Uniphase directly at 1-800-498-JDSU (5378) in North America and +800-5378-JDSU worldwide or via e-mail at sales@jdsu.com.

Please use the part number below to order the MAP 1310 to 1550 Optical Receiver.

MAPR+110O53FP

MAP 850 to 1550 nm Optical Receiver

For stand-alone applications, the MAP Broadband Source may be used as a benchtop

Key Features

- 760 to 1650 nm wavelength with multimode (MM) fiber
- Operational from 155 Mb/s to 10.51875 Gb/s data rates
- 0.5 V peak to peak (p-p) analog output
- Limited differential outputs

Applications

- Research and development (R&D) testing for 10 Gb/s Ethernet and Fiber Channel
- Transmitter component testing
- Dispersion penalty testing
- Bit error rate (BER) testing
- Manufacturing test set
- System testing

Safety Information

This cassette, when installed in a MAP chassis, complies to CE requirements plus UL3101-1 and CAN/CSA-C22.2 No. 1010.1.

The Multiple Application Platform (MAP) 850 to 1550 nm Optical Receiver Cassette is a PIN-based linear receiver which serves as a cost effective optical reference at 10 Gb/s data rates. The receiver is ideally suited for 10 Gb Ethernet and Fiber Channel applications.

The receiver can be used for applications such as testing of transmitters and transceivers. By combining the receiver with other MAP cassettes (including switches and attenuators), compact test facilities can be easily assembled.

The analog output is provided via an automatic gain controller (AGC). Therefore, the output is limited, but not squared. The analog output will be linearly related to the input but the gain will change depending on the amplitude. The digital outputs are limited.

Specifications

Parameter	Minimum	Typical	Maximum
Optical performance			
Optical wavelength - operational range	760 nm		1650 nm
Optical return loss (RL)	12 dB		
Overload		0 dBm	1.0 dBm
Sensitivity[1]			
850 nm		- 11.5 dBm	
1310 nm		- 13 dBm	
1550 nm		- 14.5 dBm	
Optical power monitoring accuracy[2]	- 1 dB		1 dB
Electrical performance			
Wideband jitter - analog output[3]			64 mUI
Bandwidth, 3dB, linear output	8 GHz	9 GHz	
Low frequency cut-off, 3 dB		100 kHz	
Output voltage, analog		0.5 V p-p	
Output voltage, limited[4]	0.3 V p-p	0.4 V p-p	0.55 V p-p
Output RL (100 kHz to 9 GHz)		10 dB	
Output coupling		AC coupled to 50 Ohms	
Output logic sense, analog		Non-inverted	
General			
Data rates		Specifications guaranteed at 9.95328, 10.3125, 10.51875 Gb/s only	
Data patterns		Pseudo-random binary sequence (PRBS) 2^{31}-1, 2^{7}-1, AnAiAnAi, BnBiBnBi, 11110000	
Optical connector		FC/PC	
Optical fiber		Multimode (MM) 62.5 µm core	
Output connector		SMA female	
Operating temperature		0 to 50 °C	
Storage temperature		- 30 to 60 °C	
Dimensions (W x H x D)		4.06 x 13.24 x 39.5 cm	
Weight		1.8 kg	

1. PRBS 231-1 bit stream at 10.3125 Gb/s, ER = 3.0 dB, BER=10-12, T = 25 °C.
2. 850, 1310, 1550 nm wavelengths only from optical input - 18 to + 1 dBm, T=25°C.
3. For optical inputs of 0 to - 7 dBm, ER = 3.0 dB, T = - 25.
4. Positive and negative outputs are limited. Cable lengths are controlled, not matched and phase difference may vary by 50 ps.

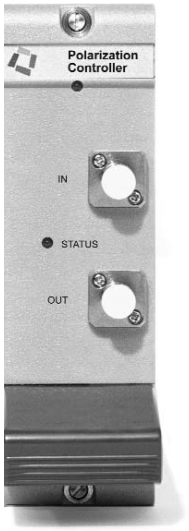
Ordering Information

For more information on this or other products and their availability, please contact your local JDS Uniphase account manager or JDS Uniphase directly at 1-800-498-JDSU (5378) in North America and +800-5378-JDSU worldwide or via e-mail at sales@jdsu.com.

Please use the part number below to order the MAP 850 to 1550 nm Optical Receiver.

MAPR+110O62FP

MAP Polarization Controller



For stand-alone applications, the MAP Polarization Controller may be used as a benchtop

Key Features

- Complete polarization control
- Designed to meet IEEE Std. 802.3ae™ 10 GbE testing requirements
- Designed to perform fast polarization dependent loss (PDL) measurements (4-state Mueller method)
- Compact single width cassette
- Very high angular accuracy and absolute fast axis alignment accuracy

Applications

- Passive component PDL and polarization mode dispersion (PMD) measurements
- EDFA noise and polarization dependent gain (PDG) measurements
- 10 GbE transceiver worst-case relative intensity noise and dispersion penalty measurements
- Optical signal to noise ratio (OSNR) and extinction ratio (ER) measurements

Safety Information

This cassette, when installed in a MAP chassis, complies to CE requirements plus UL3101-1 and CAN/CSA-C22.2 No. 1010.1.

The Multiple Application Platform (MAP) Polarization Controller Cassette provides an efficient and precise way of creating any state of polarization. It can also be used as part of a polarization state analyzer.

The single width MAP Polarization Controller Cassette is comprised of three rotating elements: a high extinction ratio polarizer, a quarter-wave plate and a half-wave plate. Each element can be controlled locally from the MAP local interface or remotely through the RS-232 or GPIB. The controller configuration can be offered with a single-mode (SM) or a polarization maintaining fiber (PMF) input.

The polarization controllers can be combined with other instruments to complete measurement test systems such as erbium-doped fiber amplifier (EDFA) or passive component test sets.

Specifications

Parameter	1310 nm	1550 nm
Wavelength range	1260 to 1360 nm	1420 to 1630 nm
Insertion loss (IL)[1, 3]	< 1.5 dB	< 1.5 dB
IL variation with wavelength[1,3]	± 0.1 dB	± 0.1 dB
IL variation with rotation[1,3,4]	± 0.05 dB	± 0.05 dB
Return loss (RL)	> 45 dB	> 45 dB
Extinction ratio[2]	> 40 dB	
Fast axis alignment accuracy	< ± 0.5 °	
Angular accuracy	± 0.1 °	
Rotational resolution	0.075 °	
Maximum rotational speed per element	900 °/s	
Maximum optical input power	200 mW	
Calibration	2 years	
Operating temperature	10 to 40 °C	
Storage temperature	-30 to 60 °C	
Humidity	Maximum 95% RH from 10 to 40 °C non-condensing	
Dimensions (W x H x D)	4.06 x 13.24 x 39.5 cm	
Weight	1.6 kg	

1. From 1520 to 1630 nm for the 1550 nm version.
2. Measured with a > 45 dB polarized narrow spectral line source.
3. At 23 °C ± 5 °C.
4. IL variation using an incoherent (broadband) source with both waveplates rotating at differing rates.

Ordering Information

For more information on this or other products and their availability, please contact your local JDS Uniphase account manager or JDS Uniphase directly at 1-800-498-JDSU (5378) in North America and +800-5378-JDSU worldwide or via e-mail at sales@jdsu.com.

Sample: MAPP+101S5FA

MAPP+10 □□ □ □□

Code	Model
1S	Controller SMF input
1P	Controller PMF input (FC connectors, 1550 nm only)

Code	Wavelength (nm)
3	1260 to 1360
5	1420 to 1630

Code	Connector Type
FP	FC/PC
FA	FC/APC
SC	SC/PC
SU	SC/APC

MAP Variable Backreflector

For stand-alone applications, the MAP Variable Backreflector may be used as a benchtop

Key Features

- 0.01 dB resolution
- Operation at 850/1310 or 1310/1550 nm
- SM or MM fiber

Applications

- Transmitter/receiver development and testing
- Reflection testing for connectors
- Quality assurance acceptance testing
- Laser development and production

Safety Information

This cassette, when installed in a MAP chassis, complies to CE requirements plus UL3101-1 and CAN/CSA-C22.2 No. 1010.1.

The Multiple Application Platform (MAP) Variable Backreflector Cassette provides precise levels of return loss (RL) to transmitters, which allows measurements of system sensitivity or system degradation as a function of backreflection.

When used with a transmitter/receiver pair and characterization equipment, the backreflector can be used to establish the magnitude of reflections that significantly degrade transmission system performance, and to characterize the problems they cause.

The backreflector uses JDS Uniphase's linear attenuator prism and high reflectivity mirror to precisely control the level of RL. The cassette is available in single-mode (SM) or multimode (MM) fibers and with an optional coupler for monitoring.

Continued

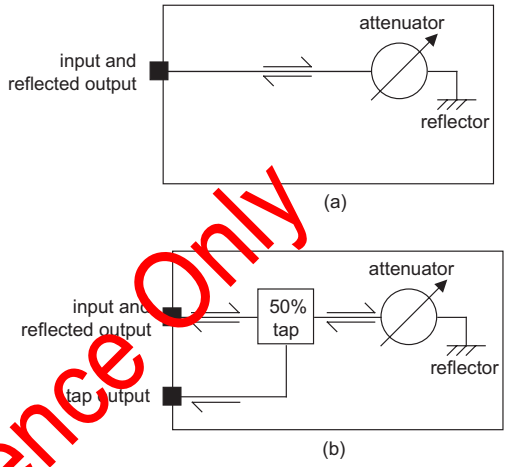


Figure 1: Optical configurations for the variable backreflector cassette.
a) without coupler,
b) with coupler

Specifications

Parameter	Single-mode fiber (SMF)		Multimode fiber (MMF)	
	Without Coupler	With 50/50 Coupler	Without Coupler	With 50/50 Coupler
Wavelength range	1260 to 1650 nm		750 to 1350 nm	
Maximum backreflection level	> - 5.0 dB	> - 9.5 dB	> - 5.0 dB	> - 9.5 dB
Minimum backreflection level (APC/PC)	< - 60/< - 45 dB		- 30/< - 30 dB	
Insertion loss (IL)(IN to OUT) [1,2,3]	N/A	< 5.0 dB	N/A	< 6.0 dB
Relative backreflection setting accuracy [1,3,4]	± 0.2		± 0.4	
Backreflection setting resolution	0.01		0.01	
Fiber type	9/125 µm		50/125 or 62.5/125 µm	
Polarization dependent loss (PDL)[1]	< 1.0 dB		N/A	
Maximum optical input power	200 mW			
Calibration period	2 years			
Warm-up time	30 minutes			
Operating temperature	0 to 50 °C			
Storage temperature	- 30 to 60 °C			
Humidity	< 90 % at 23 °C, < 20 % at 50 °C (relative non-condensing)			
Dimensions (W x H x D)	single width cassette (4.06 x 13.24 x 39.5 cm)			
Weight	1.1 kg (single) / 1.3 kg (dual)			

1. At 1310 ± 15 and 1550 ± 15 nm for SM units and at 850 ± 15 nm and 1310 ± 15 nm for MM units.
2. Including one mated pair of connectors.
3. At 23 ± 5 °C.
4. From maximum backreflection to - 40 dB for SM units and from maximum backreflection to - 25 dB for MM units.

Ordering Information

For more information on this or other products and their availability, please contact your local JDS Uniphase account manager or JDS Uniphase directly at 1-800-498-JDSU (5378) in North America and +800-5378-JDSU worldwide or via e-mail at sales@jdsu.com.

Sample: MAPV+2B70100FA

MAPV+2B □□ □ □ **0** □□

Code	Fiber Type (µm)
19	50/125
29	62.5/125
70	9/125

Code	Cassette Type
1	single
2	dual

Code	Built-in Option
0	none
1	coupler

Code	Port Type
0	bulkheads

Code	Connector Type
FP	FC/PC
FA	FC/APC
SC	SC/PC
SU	SC/APC

MAP Tunable Grating Filter

For stand-alone applications, the MAP Tunable Grating Filter may be used as a benchtop

Key Features

- Narrow bandwidth
- Low polarization dependent loss (PDL) (< 0.3 dB)
- Wide wavelength range (1420 to 1630 nm)
- High power input (1 W)

The Multiple Application Platform (MAP) Tunable Grating Filter Cassette is a tunable bandpass filter that offers continuous wavelength tuning from 1420 to 1630 nm. It is used for applications requiring low insertion loss (IL), high rejection, narrow bandwidth and wavelength tuning resolution of 0.005 nm. The standard model has a maximum input power of 300 mW and the high power option provides a maximum input power of 1000 mW.

Three options are available:

- the peak search option, used to find the absolute maximum transmission power within the filter's wavelength tuning range or a local maximum transmission power within a user-defined wavelength range
- 10% tap option for power monitoring
- 50% tap option for power monitoring.

MAP Tunable Grating Filter Cassette is ideal for applications where the user needs to suppress amplified spontaneous emissions (ASE) or isolate specific wavelengths. These applications include amplifier characterization, bit error rate (BER) testing and optical signal to noise ratio (OSNR) measurement.

The MAP Tunable Grating Filter Cassette is the next generation replacement of the Benchtop Tunable Grating Filter (TB9 series).

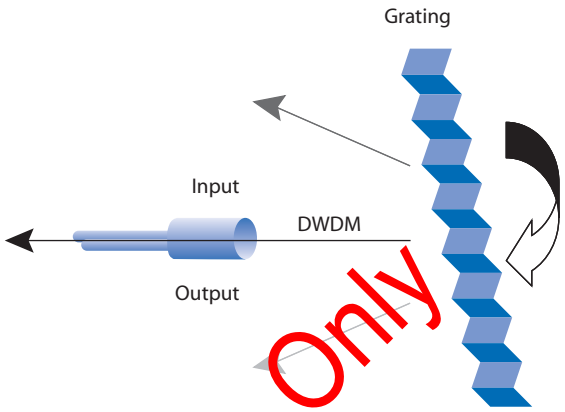
Applications

- Spontaneous emission suppression
- Amplifier characterization (Up to 1 W of input power)
- BER testing
- Tunable laser based testing

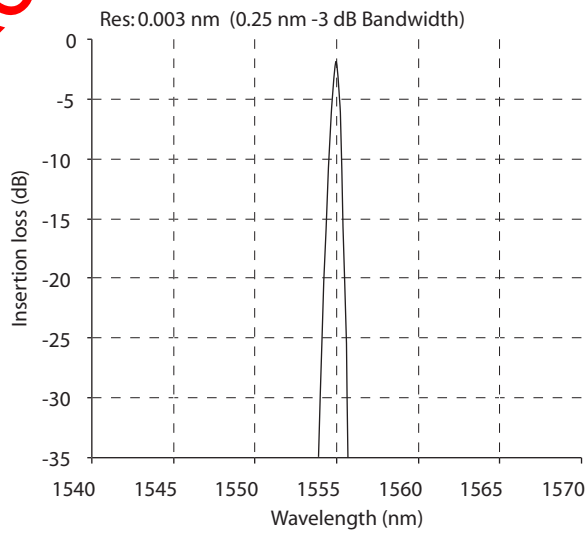
Safety Information

This cassette, when installed in a MAP chassis, complies to CE requirements plus UL3101-1 and CAN/CSA-C22.2 No. 1010.1.

Continued



The filter makes use of a diffraction grating to separate the input light along several discrete paths. A stepper-motor rotates the grating to transmit the desired wavelength along the output fiber.



Model "G" filter shape shows the low IL and sharpness of the filter.

Specifications

Parameter	Model C	Model G	Model K
Wavelength range	1420 to 1630 nm	1420 to 1630 nm	1420 to 1630 nm
Optical shape	Gaussian	Gaussian	Gaussian
- 3 dB bandwidth[1]	0.11 nm ± 15%	0.25 nm ± 15%	0.55 nm ± 15%
3/20 dB ratio[1]	0.40 ± 0.05	0.31 ± 0.05	0.31 ± 0.05
Insertion loss (IL)[2]			
(1520 to 1630 nm)	< 6.0 dB	< 4.5 dB	< 4.5 dB
(1450 to 1630 nm)	< 8.0 dB	< 6.0 dB	< 6.0 dB
Input power[3]	300 mW or 1 W		300 mW
Return loss (RL)[4]	45 dB		
Wavelength resolution	0.005 nm		
Polarization dependent loss (PDL)[5] (1480 to 1630 nm)	< 0.3 dB		
Tuning speed	> 5 nm/s		
Peak to average background noise	> 45 dB		
Accuracy	± 0.2 nm		
Peak search accuracy	< 0.2 dB from output peak power		
Polarization mode dispersion (PMD)	< 0.3 ps		
Group delay variation within a - 3 dB bandwidth	< 5 ps		
Recommended calibration period	1 year		
Operating temperature	10 to - 40 °C		
Storage temperature	- 10 to 60 °C		
Dimensions (W x H x D)	8.12 x 13.24 x 39.5 cm		
Weight	2.3 kg		

1. Measured at 1550 nm.
2. Not including tap coupler loss if installed.
3. At 23 °C ± 5 °C.
4. At selected wavelength.
5. Input power is within the range of - 20 dBm to +20 dBm. Excludes PDL effect.

Ordering Information

For more information on this or other products and their availability, please contact your local JDS Uniphase account manager or JDS Uniphase directly at 1-800-498-JDSU (5378) in North America and +800-5378-JDSU worldwide or via e-mail at sales@jdsu.com.

Sample: MAPF+1GGP51FP

MAPF +1G □ □ □ **1** □ □

Code	Bandwidth
C	Model C (0.11 nm)
G	Model G (0.25 nm)
K	Model K (0.55 nm)

Code	Input Power
0	300 mW
P	1 W (Models C and G only)

Code	Option
0	None
1	50/50 coupler
9	10/90 coupler
X	Peak search

Code	Port Type
1	Bulkheads

Code	Connector Types
FP	FC/PC
FA	FC/APC
SC	SC/PC
SU	SC/APC

If the configurations available do not meet your performance requirements, please contact our global sales and customer service team to discuss the potential for specialized solutions.

MAP Power Meter

3 mm InGaAs Power Meter with Dual Detector Configuration

For stand-alone applications, the MAP Power Meter may be used as a benchtop

Key Features

- Low PDL (< 0.01 dB)
- Wide wavelength range (800 to 1650 nm)
- High power option (2 W)
- Dual detector option
- Bare fiber measurements capability

Applications

- Dense wavelength division multiplexing (DWDM) channel measurements (Up to 128 channels/controller addresses)
- Amplifier characterization (Up to 2 W of input power)
- Bit error rate (BER) testing
- Precise optical power control (± 0.01 dB)
- Receiver and transmitter testing

Safety Information

This cassette, when installed in a MAP chassis, complies to CE requirements plus UL3101-1 and CAN/CSA-C22.2 No. 1010.1.

JDS Uniphase offers two types of Multiple Application Platform (MAP) Power Meter Cassettes. The first is a power meter with a 3 mm InGaAs detector and the second is a power meter with 10 mm Ge detector.

3 mm InGaAs MAP Power Meter

The Power Meter is optimized for applications using single-mode (SM) or multimode (MM) fiber to measure power levels from - 80 to 10 dBm over the wavelength range of 800 to 1650 nm. It features a high accuracy, high linearity and extremely low polarization dependent loss (PDL). The MAP Power Meter Cassette with 3 mm InGaAs detector is available in single or dual configuration and comes with an analog electrical output for external monitoring. The averaging time can be set as low as 100 µs for high-speed applications.

For ultimate flexibility, the detector heads were designed with the JDS Uniphase AC100 interchangeable detector adapters. Detector adapters are available for six connector types as well as a fiber holder that permits bare fiber measurements (please refer to the Optional Accessories section). The cassette is supplied with an FC detector adapter as a standard accessory. An optional integrating sphere may be fastened to the front panel allowing for increased power measurement capability to 33 dBm (2 W) with decreased PDL to 0.005 dB.

Continued

Dual Detector Power Meter with an Integrating Sphere on Detector 2

10 mm Ge Power Meter

10 mm Ge MAP Power Meter

This versatile power meter can be used in applications using standard SM or MM fiber as well as SM or MM ribbon cable with fiber counts as high as 72 (see Specifications for further details). The power meter can accurately measure power levels from - 50 to 3 dBm over the wavelength range of 800 to 1650 nm.

The detector heads are compatible with the JDS Uniphase AC400 series interchangeable detector adapters (please refer to the Optional Accessories section). The cassette is supplied with an FC detector adapter as a standard accessory.

Specifications

Parameter	3 mm InGaAs MAP Power Meter	10 mm Ge MAP Power Meter
Sensor element	3 mm InGaAs	10 mm Ge
Wavelength range	800 to 1650 nm	800 to 1650 nm
Power range	- 80 to 10 dBm	- 50 to 3 dBm
Fiber type	SMF and MMF with N/A ≤ 0.27	
Maximum core diameter for single fiber	62.5 µm (N/A ≤ 0.27)	
Maximum core diameter for ribbon cable[1]	N/A	62.5 µm (N/A ≤ 0.27)
Uncertainty at reference condition	± 2.5 % (1200 ≤ λ ≤ 1550 nm)[2]	± 4 %[3]
	± 4.0 % (800 ≤ λ< 1200 nm)[2]	
	± 3.5 % (1550 ≤ λ ≤ 1600 nm)[2]	
	± 4.0 % (1600 ≤ λ ≤ 1630 nm)[2]	
Total uncertainty[4,5]	± 4.5 % ± 5 pW (800 ≤ λ ≤ 1630 nm)	± 5.5 % ± 100 pW
Relative uncertainty		
polarization[6]	± 0.01 dB	< 0.01 dB
spectral ripple[7]	± 0.005 dB	< 0.01 dB
Linearity (at T = 23 ± 5 °C)	1520 ≤ λ ≤ 1570 nm - 65 to - 10 dBm < ± 0.02 dB	± 0.025 dB[8]
Return loss (RL)[9]	> 55 dB	> 50 dB
Noise[10] (peak to peak)	< 5 pW	< ± 100 pW
Averaging time	100 µs to 5 s	100 µs to 5 s
Analog output	0 to 2 volts	N/A
Recalibration period	1 year	1 year
Warm-up time	20 minutes	20 minutes
Operating temperature	5 to 40 °C	
Humidity	non-condensing	
Dimensions (W x H x D)	4.06 x 13.24 x 39.5 cm	8.12 x 13.24 x 39.5 cm
Weight	1.2 kg	

1. Six rows of 12 fibers with a 0.250 mm vertical and horizontal pitch.
2. Reference condition: Fiber type: SMF-28, Ambient temperature: 23 ± 3 °C, Spectral width of source: < 1 nm, Optical power on detector: 100 µW (- 10 dBm).
3. Reference condition: CW laser with P = - 10 dBm; Wavelength 1550 nm; FWHM < 10 nm; SM fiber with single channel FC connector adapter; Ambient temperature 25 ± 3 °C.
4. Operating conditions: NA of fiber ≤ 0.27 Temperature, humidity and power ranges: as specified. For FC/APC connector N/A = 0.27 add 1 %.
5. For wavelengths >1600 nm and temperatures > 35 °C add 1.0 %.
6. Polarization: Polarization states at fixed wavelength (1550 ± 30 nm) and constant power; Straight connector; T = 23 ± 5 °C.
7. Ripple: 1545 ≤ λ ≤ 1565 nm; Fixed state of polarization; Constant power; Straight connector; T = 23 ± 5 °C.
8. For 3 dBm > P > - 30 dBm.
9. RL: At 1310 nm and 1550 nm; 8 ° angled connector; T = 23 ± 5 °C.
10. Noise: Averaging time 1 s; Observation time 300 s; Wavelength 1550 nm; T = 23 ± 5 °C.

Specifications

Integrating Sphere Specifications Parameter (Part Number AC330)	Specification
Attenuation at reference[1]	- 30.7 ± 0.8 dB
Spectral range	800 to 1650 nm
Wavelength flatness[2]	< ± 1.5 dB
RL[3]	Typical > 65 dB
Relative uncertainty[4]	< ± 0.05 dB
Residual polarization dependent loss (PDL)[5]	< 0.005 dB
Maximum power[6]	+ 33 dBm (2 W)
Operating temperature	10 to 40 °C, RH 15 % to 70 %
Storage temperature	- 30 to 60 °C, RH 15 % to 95 % non-condensing

1. Measured with wavelength of 1550 nm at 23 ± 5°C and RH = 50% with straight connector.
2. From 850 nm to 1650 nm, refer to the wavelength of 1310 nm.
3. Measured at 1310 nm and 1550 nm with SM fiber and FC/APC connector.
4. At reference condition, with 8 degree angled connector, due to the polarization and interference.
5. Measured at 1550 nm.
6. Continuous Wave (CW) laser.

Ordering Information

For more information on this or other products and their availability, please contact your local JDS Uniphase account manager or JDS Uniphase directly at 1-800-498-JDSU (5378) in North America and +800-5378-JDSU worldwide or via e-mail at sales@jdsu.com.

Sample: MAPM+2PS12

MAPM +2P [S] [ ] [ ]

Code	Detector Type
S	Performance standard

Code	Detector[1] Type
1	3 mm InGaAs
2	10 mm Ge

Code	Detector[2] Type
0	None
1	3 mm InGaAs
2	10 mm Ge[1]

1. Not applicable if a 10 mm detector has been ordered for detector
2. A Dual 10 mm Ge detector cannot be ordered.

Optional Accessories

3 mm InGaAs MAP Power Meter

Part Numbers	Description
AC100	Detector cap
AC101	FC detector adapter
AC102	ST detector adapter
AC103	SC detector adapter
AC112	MT ribbon cable adapter
AC114	MU detector adapter
AC115	E2000 detector adapter
AC120	Magnetic fiber holder (requires AC121)
AC121	Single bare fiber plug (requires AC120)
AC330	+33 dBm integrating sphere

10 mm Ge MAP Power Meter

Part Numbers	Description
AC400	Detector cap
AC401	FC/PC adapter
AC402	MPO/MTP adapter

MAP Broadband Source

For stand-alone applications, the MAP Broadband Source may be used as a benchtop

Key Features

- Flattened output power spectrum
- High output power density
- High spectral stability
- Control and monitoring features

Applications

- Optical component spectral tests
- Systems compliance tests
- Optical measurement systems
- Sensor and imaging experiments

Safety Information

This optical source cassette, when installed in the MAP chassis, complies to CE requirements plus UL3101-1 and CAN/CSA-C22.2 No.1010.1, meets the requirements of Class 3B in standard IEC 60825-1(2002), and complies with 21 CFR 1040.1 except deviations per Laser Notice No.50, July 2001.

INVISIBLE LASER RADIATION
AVOID EXPOSURE TO BEAM
CLASS 3B LASER PRODUCT
~~(IEC 60825-1, 2002)~~
MAX. 500 mw, 700-1680 nm

The Multiple Application Platform (MAP) Broadband Source (BBS) Cassette combines the optical performance of the JDS Uniphase BBS benchtop instruments with the flexibility and modularity of the MAP.

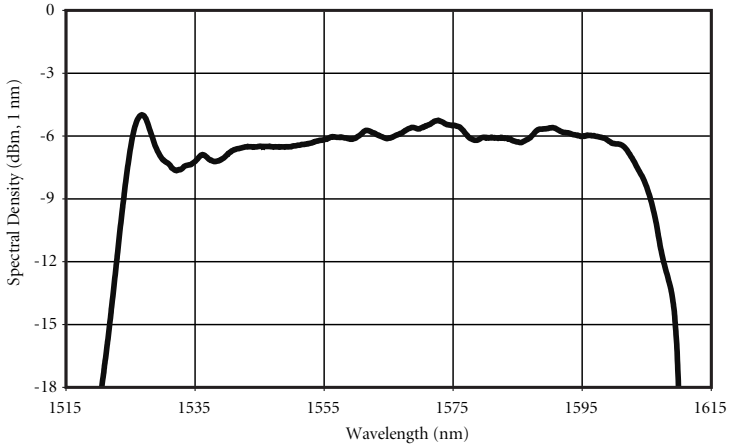
Utilizing the latest advances in erbium technology, the MAP BBS offers an amplified spontaneous emission (ASE) output that features flattened high power density across the C-band or C+L-band. The source provides high spectral stability.

The addition of the BBS Cassette can be used for many applications including OSNR (optical signal to noise ratio) experiments, calibration of test equipment, and noise source for active or passive component testing.

The MAP BBS models provide specialized variants and optical performance not available in the Benchtop BBS. Additional BBS models are available in the Benchtop BBS product line for applications requiring higher output power.

Continued

Spectral Density Plot
MAPB+1E1550 C-band 50 mW



Spectral Density Plot
MAPB+1E1560 C+L-band 20 mW

Specifications

Parameter	1550 50 mW Output Power	1550 100 mW Output Power	1560 20 mW Output Power
Operating wavelength range	1527 to 1568 nm	1525 to 1568 nm	1525 to 1610 nm
Total optical power (minimum)[1]	50 mW	100 mW	20 mW
Spectral gain flatness (maximum)[2]	1.6 dB	1.6 dB	2.5 dB
Total output power stability		0.02 dB	
Output isolation (minimum)		45 dB	
Operating temperature		0 to 50 °C	
Storage temperature		- 30 to 60 °C	
Humidity		maximum 95 % RH non-condensing from 0 to 45 °C	
Dimensions (W x H x D)		4.06 x 13.24 x 39.5 cm	
Weight		2.3 kg	

1. Measured at 1550 nm at 23 °C after one hour warm up.
2. Flatness range 1529 to 1565 nm for 1550 model and 1526 to 1603 nm for 1560 model.

Ordering Information

For more information on this or other products and their availability, please contact your local JDS Uniphase account manager or JDS Uniphase directly at 1-800-498-JDSU (5378) in North America and +800-5378-JDSU worldwide or via e-mail at sales@jdsu.com.

Sample: MAPB+1E1550FP0

MAPB +1E □□□□ □□ □

Code	Band
1550	C-band, 1527 to 1568 nm
1560	C+L-band, 1525 to 1610 nm

Code	Connector Type
FP	FC/PC
FA	FC/APC

Code	Output power
0	50 mW output power for C-band, 20 mW for C+L-band
1	100 mW output power (C-band only)

If the configurations available do not meet your performance requirements, please contact our global sales and customer service team to discuss the potential for specialized solutions.

MAP DFB Laser

For stand-alone applications, the MAP DFB Laser may be used as a benchtop

Key Features

- One or two DFB laser(s) per cassette
- 1.5 nm of wavelength tuning range
- 10 or 20 mW output power
- 200 Hz to 400 kHz modulation
- 50 GHz wavelength spacing
- Single-mode fiber (SMF) and polarization maintaining fiber (PMF) output available

Applications

- DWDM transmission testing
- Optical amplifier testing
- Fiber characterization

Safety Information

This optical source cassette, when installed in the MAP chassis, complies to CE requirements plus UL3101-1 and CAN/CSA-C22.2 No.1010.1, meets the requirements of Class 3B in standard IEC 60825-1(2002), and complies with 21 CFR 1040.1 except deviations per Laser Notice No.50, July 2001.

INVISIBLE LASER RADIATION
AVOID EXPOSURE TO BEAM
CLASS 3B LASER PRODUCT
(IEC 60825-1, 2002)
MAX. 500 mw, 700-1680 nm

The Multiple Application Platform (MAP) Distributed Feedback (DFB) Laser Cassette is an excellent source for dense wavelength division multiplexing (DWDM) system testing. A combination of DFB lasers may be used to create an ITU grid in which optical frequency represented by a DFB laser corresponds to the transmitter in the optical network. The standard MAP DFB Laser can be selected to comply with the 50 GHz ITU grid in the C- and L-band (1527 to 1610 nm). The lasers typically show a side-mode suppression ratio of 40 dB and can be modulated internally from 0.2 to 400 kHz in square, sinusoidal and triangular waves.

Specifications

Parameter	Specification
Wavelength	
Range	ITU grid C+L-band (see Channel Code Grid)
Accuracy	± 0.03 nm
Stability 15 minutes[1, 2, 3]	± 0.005 nm
Stability 24 hours[1, 2, 3]	± 0.01 nm
Tuning range	≥ 1.5 nm
Resolution	0.01 nm
Power	
Laser output[4]	10 or 20 mW
Laser power uncertainty[3]	± 5 %
Stability 15 minutes[1, 2, 3]	± 0.005 dB
Stability 24 hours[1, 2, 3]	± 0.03 dB
Resolution[5]	0.01 dB
Attenuation range	10 dB
Internal modulation	
Range[6]	0.2 to 400 kHz
Depth	0 to 100 %
Duty cycle	15 to 85 %
Function	Square, Sinusoidal and Triangular
Spectral properties	
Width coherence control off	< 30 MHz
Width coherence control on	> 500 MHz
Side mode suppression ratio (SMSR)	≥ 40 dB
Optical signal to noise ratio (OSNR) (peak to maximum background)	30 dB
Optical isolation	30 dB
Relative intensity noise (RIN)	- 140 dB/Hz
Recommended calibration period	1 year
Operating temperature	10 to 40 °C
Storage temperature	- 30 to 60 °C
Dimensions (W x H x D)	4.06 x 13.24 x 39.5 cm
Weight	0.5 kg

1. At full power.
2. After 1 hour warm-up.
3. Constant temperature within 25 ±3 °C.
4. Not including options.
5. For maximum power to (maximum power - 8 dB).
6. Nominal duty cycle is accurate from 0.2 to 100 kHz. Analog modulation bandwidth is 400 kHz.

Channel Code Grid

Code	Frequency (THz)	Wavelength (nm)
18620	186.20	1610.06
18625	186.25	1609.62
18630	186.30	1609.19
18635	186.35	1608.76
18640	186.40	1608.33
18645	186.45	1607.90
18650	186.50	1607.47
18655	186.55	1607.04
18660	186.60	1606.61
18665	186.65	1606.17
18670	186.70	1605.74
18675	186.75	1605.31
18680	186.80	1604.89
18685	186.85	1604.46
18690	186.90	1604.03
18695	186.95	1603.60
18700	187.00	1603.17
18705	187.05	1602.74
18710	187.10	1602.31
18715	187.15	1601.88
18720	187.20	1601.46
18725	187.25	1601.03
18730	187.30	1600.60
18735	187.35	1600.17
18740	187.40	1599.75
18745	187.45	1599.32
18750	187.50	1598.89
18755	187.55	1598.47
18760	187.60	1598.04
18765	187.65	1597.62
18770	187.70	1597.19
18775	187.75	1596.76
18780	187.80	1596.34
18785	187.85	1595.91
18790	187.90	1595.49
18795	187.95	1595.07
18800	188.00	1594.64
18805	188.05	1594.22
18810	188.10	1593.79
18815	188.15	1593.37
18820	188.20	1592.95
18825	188.25	1592.52
18830	188.30	1592.10
18835	188.35	1591.68
18840	188.40	1591.26
18845	188.45	1590.83
18850	188.50	1590.41
18855	188.55	1589.99
18860	188.60	1589.57
18865	188.65	1589.15
18870	188.70	1588.73
18875	188.75	1588.30
18880	188.80	1587.88
18885	188.85	1587.46
18890	188.90	1587.04
18895	188.95	1586.62
18900	189.00	1586.20
18905	189.05	1585.78
18910	189.10	1585.37
18915	189.15	1584.95
18920	189.20	1584.53
18925	189.25	1584.11
18930	189.30	1583.69
18935	189.35	1583.27
18940	189.40	1582.85
18945	189.45	1582.44
18950	189.50	1582.02
18955	189.55	1581.60
18960	189.60	1581.18
18965	189.65	1580.77
18970	189.70	1580.35
18975	189.75	1579.93
18980	189.80	1579.52
18985	189.85	1579.10
18990	189.90	1578.69
18995	189.95	1578.27
19000	190.00	1577.86
19005	190.05	1577.44
19010	190.10	1577.03
19015	190.15	1576.61
19020	190.20	1576.20
19025	190.25	1575.78
19030	190.30	1575.37
19035	190.35	1574.95
19040	190.40	1574.54
19045	190.45	1574.13
19050	190.50	1573.71
19055	190.55	1573.30
19060	190.60	1572.89
19065	190.65	1572.48
19070	190.70	1572.06
19075	190.75	1571.65
19080	190.80	1571.24
19085	190.85	1570.83
19090	190.90	1570.42
19095	190.95	1570.01
19100	191.00	1569.59
19105	191.05	1569.18
19110	191.10	1568.77
19115	191.15	1568.36
19120	191.20	1567.95
19125	191.25	1567.54
19130	191.30	1567.13
19135	191.35	1566.72
19140	191.40	1566.31
19145	191.45	1565.91
19150	191.50	1565.50
19155	191.55	1565.09
19160	191.60	1564.68
19165	191.65	1564.27
19170	191.70	1563.86
19175	191.75	1563.46
19180	191.80	1563.05
19185	191.85	1562.64
19190	191.90	1562.23
19195	191.95	1561.83
19200	192.00	1561.42
19205	192.05	1561.01
19210	192.10	1560.61
19215	192.15	1560.20
19220	192.20	1559.80
19225	192.25	1559.39
19230	192.30	1558.98
19235	192.35	1558.58
19240	192.40	1558.17
19245	192.45	1557.77
19250	192.50	1557.36
19255	192.55	1556.96
19260	192.60	1556.56
19265	192.65	1556.15
19270	192.70	1555.75
19275	192.75	1555.34
19280	192.80	1554.94
19285	192.85	1554.54
19290	192.90	1554.13
19295	192.95	1553.73
19300	193.00	1553.33
19305	193.05	1552.93
19310	193.10	1552.52
19315	193.15	1552.12
19320	193.20	1551.72
19325	193.25	1551.32
19330	193.30	1550.92
19335	193.35	1550.52
19340	193.40	1550.12
19345	193.45	1549.72
19350	193.50	1549.32
19355	193.55	1548.92
19360	193.60	1548.52
19365	193.65	1548.12
19370	193.70	1547.72
19375	193.75	1547.32
19380	193.80	1546.92
19385	193.85	1546.52
19390	193.90	1546.12
19395	193.95	1545.72
19400	194.00	1545.32
19405	194.05	1544.92
19410	194.10	1544.53
19415	194.15	1544.13
19420	194.20	1543.73
19425	194.25	1543.33
19430	194.30	1542.94
19435	194.35	1542.54
19440	194.40	1542.14
19445	194.45	1541.75
19450	194.50	1541.35
19455	194.55	1540.95
19460	194.60	1540.56
19465	194.65	1540.16
19470	194.70	1539.77
19475	194.75	1539.37
19480	194.80	1538.98
19485	194.85	1538.58
19490	194.90	1538.19
19495	194.95	1537.79
19500	195.00	1537.40
19505	195.05	1537.00
19510	195.10	1536.61
19515	195.15	1536.22
19520	195.20	1535.82
19525	195.25	1535.43
19530	195.30	1535.04
19535	195.35	1534.64
19540	195.40	1534.25
19545	195.45	1533.86
19550	195.50	1533.47
19555	195.55	1533.07
19560	195.60	1532.68
19565	195.65	1532.29
19570	195.70	1531.90
19575	195.75	1531.51
19580	195.80	1531.12
19585	195.85	1530.73
19590	195.90	1530.33
19595	195.95	1529.94
19600	196.00	1529.55

Ordering Information

For more information on this or other products and their availability, please contact your local JDS Uniphase account manager or JDS Uniphase directly at 1-800-498-JDSU (5378) in North America and +800-5378-JDSU worldwide or via e-mail at sales@jdsu.com.

MAP Single DFB Laser Cassette
Sample: MAPL+2U119630190FP

MAPL +2U1 □□□□□ □ □ □ □□

Code	Channel Code
XXXXX	See channel code grid

Code	Tap Option
0	None
4	1/99 coupler

Code	Output Power
1	10 mW
2	20 mW

Code	Connector Type Bulkheads
FP	FC/PC
FA	FC/APC

Code	Fiber Type, With Options
7	SMF28, no option
9	PMF, no option

MAP Dual DFB Laser Cassette
Sample : MAPL+2U2196301962027FP

MAPL+2U2 □□□□□ □□□□□ □ □ □□

Code	Channel Code
XXXXX	See channel code grid

Code	Channel Code
XXXXX	See channel code grid

Code	Output Power
1	10 mW
2	20 mW

Code	Connector Type Bulkheads
FP	FC/PC
FA	FC/APC

Code	Fiber Type, Option
7	SMF28, no option
9	PMF, no option
5	SMF28, monitor port 1 % option
4	PMF, monitor port 1 % option

If the configurations available do not meet your performance requirements, please contact our global sales and customer service team to discuss the potential for specialized solutions.

MAP DFB Laser - Analog Modulation

For stand-alone applications, the MAP DFB Laser - may be used as a benchtop

Key Features

- 10 mW output power
- 1 GHz of modulation bandwidth
- Very low second and third order distortion

Applications

- CATV reference transmitter
- Multitone receiver test

Safety Information

This optical source cassette, when installed in the MAP chassis, complies to CE requirements plus UL3101-1 and CAN/CSA-C22.2 No.1010.1, meets the requirements of Class 3B in standard IEC 60825-1(2002), and complies with 21 CFR 1040.1 except deviations per Laser Notice No.50, July 2001.

INVISIBLE LASER RADIATION
AVOID EXPOSURE TO BEAM
CLASS 3B LASER PRODUCT
(IEC 60825-1, 2002)
MAX. 500 mw, 700-1680 nm

Multiple Application Platform (MAP) DFB Laser Cassette with Analog Modulation features 1 GHz of modulation bandwidth and low distortion for accurate CATV receiver testing. The cassette features a built-in laser-bias driver and thermo-electric cooler controller for optimal wavelength and power stability.

The radio frequency (RF) modulation is applied through an SMA connector (50 Ohm impedance) on the front panel of the cassette. The RF path is an unamplified connection directly to the laser through an integrated bias-T.

Specifications

Parameter	Specification
Maximum radio frequency (RF) input power	+ 13 dBm
Wavelength	1550.1 nm
Wavelength accuracy	± 0.1 nm
Laser peak output power	10 dBm
Laser power uncertainty [1,2,3]	± 5 %
Stability 24 hours[1,2,3]	± 0.1 dB
Side mode suppression ratio (SMSR)	> 30 dB
Optical isolation	> 30 dB
Optical return loss (RL)	> 40 dB
Relative intensity noise (RIN)	< - 157 dB/Hz
Recommended calibration period	1 year
Spectral linewidth	< 3.0 MHz
Bandwidth	1 GHz
Second order distortion[4]	< - 34 dBc
Third order distortion[4]	< - 44 dBc
Operating temperature	10 to 40 °C
Storage temperature	- 30 to 60 °C
Dimensions (W x H x D)	4.06 x 13.24 x 30.5 cm
Weight	0.5 kg

1. At full power.
2. After one hour warm-up.
3. Constant temperature within 25 ± 3°C.
4. $I_F = I_{op}$, 35% OMI, F1= 595.25 MHz, F2=553.25 MHz.

Ordering Information

For more information on this or other products and their availability, please contact your local JDS Uniphase account manager or JDS Uniphase directly at 1-800-498-JDSU (5378) in North America and +800-5378-JDSU worldwide or via e-mail at sales@jdsu.com.

Sample: MAPL+1A119340FA

MAPL+1A [1] [1][9][3][4][0] [ ][ ]

Code	Number of Channels
1	Single channel

Code	Channel Code
19340	1550.12 nm wavelength

Code	Connector Type
FP	FC/PC
FA	FC/APC

If the configurations available do not meet your performance requirements, please contact our global sales and customer service team to discuss the potential for specialized solutions.

MAP Fabry-Perot Laser

For stand-alone applications, the MAP Fabry-Perot Laser may be used as a benchtop

Key Features

- Dual independent sources available in a single cassette
- Control and monitoring features
- Single-mode (SM)/Multimode (MM) output
- Internal/external modulation

Applications

- Insertion loss (IL)
- Return loss (RL)
- Polarization dependent loss (PDL) tests
- Dense wavelength division multiplexing (DWDM) test

The Multiple Application Platform (MAP) Fabry-Perot Laser Cassette consists of a Fabry-Perot laser diode combined with a high performance laser driver circuitry for optimal wavelength and power stability. It features internal and external modulation capabilities and variable power control. Cassettes can be configured with two independent sources for maximum instrumentation density.

Safety Information

This optical source cassette, when installed in the MAP chassis, complies to CE requirements plus UL3101-1 and CAN/CSA-C22.2 No.1010.1, meets the requirements of Class 3B in standard IEC 60825-1(2002), and complies with 21 CFR 1040.1 except deviations per Laser Notice No.50, July 2001.

INVISIBLE LASER RADIATION
~~AVOID EXPOSURE TO BEAM~~
CLASS 3B LASER PRODUCT
(IEC 60825-1, 2002)
MAX. 500 mw, 700-1680 nm

Specifications

Single-mode (SM)

Parameter	980 nm	1310 nm	1480 nm	1550 nm	1625 nm	1650 nm
Peak wavelength	980 ± 20 nm	1310 ± 20 nm	1480 ± 20 nm	1550 ± 20 nm	1625 ± 20 nm	1650 ± 20 nm
Spectral width (FWHM)	< 5 nm	< 5 nm	< 5 nm	< 6 nm	< 7 nm	< 7 nm
Total power[1,2]	0 dBm	- 3 dBm	- 3 dBm	- 3 dBm	- 3 dBm	- 3 dBm
Fiber type	Flexcor™	SMF-28	SMF-28	SMF-28	SMF-28	SMF-28
Modulation[3]	0.2 to 20 kHz					
Stability (15 minutes)[1,2,4]	± 0.005 dB					
Connector type	FC/PC, FC/APC					
Operating temperature	10 to 40 °C					
Storage temperature	- 30 to 60 °C					
Dimensions (W x H x D)	4.06 x 13.24 x 39.5 cm					
Weight	0.5 kg					

Multimode (MM)

Parameter	850 nm	1310 nm	1550 nm
Peak wavelength	850 ± 20 nm	1310 ± 20 nm	1550 ± 20 nm
Spectral width (FWHM)	< 8 nm	< 8 nm	< 8 nm
Total power[1,2]	- 3 dBm	- 6 dBm	- 6 dBm
Modulation[3]	0.2 to 20 kHz		
Stability (15 minutes)[1,2,4]	± 0.01 dB		
Connector type	FC/PC, FC/APC		
Operating temperature	10 to 40 °C		
Storage temperature	- 30 to 60 °C		
Dimensions (W x H x D)	4.06 x 13.24 x 39.5 cm		
Weight	0.5 kg		

1. After 30 minute warm-up.
2. Measured at constant temperature of 23 ± 5°C .
3. Modulation duty cycle is adjustable from 15 % to 85 %. Modulation depth is fixed at 100 %.
4. Measured at full power.

Ordering Information

For more information on this or other products and their availability, please contact your local JDS Uniphase account manager or JDS Uniphase directly at 1-800-498-JDSU (5378) in North America and +800-5378-JDSU worldwide or via e-mail at sales@jdsu.com.

Sample: MAPL+1F072FA

MAPL+1F [0] [ ] [ ] [ ] [ ]

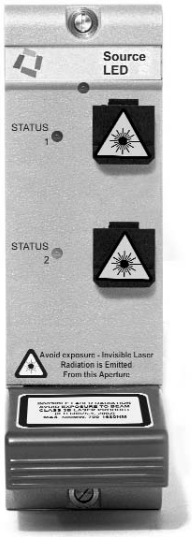
Code	Output Power
0	Standard

Code	Wavelength (nm)
1	850
2	980
3	1310
4	1480
5	1550
6	1625
7	1310/1550
8	1650
9	850/1310
A	1550/1625
B	1550/1650
C	1480/1550

Code	Fiber Type (μm)
1	50/125
2	62.5/125
7	9/125
8	Flexcor 1060

Code	Connector Type
FP	FC/PC
FA	FC/APC

MAP Light Emitting Diode Source



For stand-alone applications, the MAP LED Source may be used as a benchtop

Key Features

- Dual independent sources available in a single cassette
- Control and monitoring features
- Single-mode (SM)/Multimode (MM) output
- Internal/external modulation circuitry

Applications

- Optical component spectral tests
- Systems compliance tests
- Sensors and imaging

Safety Information

This optical source cassette, when installed in the MAP chassis, complies to CE requirements plus UL3101-1 and CAN/CSA-C22.2 No.1010.1, meets the requirements of Class 3B in standard IEC 60825-1(2002), and complies with 21 CFR 1040.1 except deviations per Laser Notice No.50, July 2001.

INVISIBLE LASER RADIATION
AVOID EXPOSURE TO BEAM
CLASS 3B LASER PRODUCT
(IEC 60825-1, 2002)
MAX. 500 mw, 700-1680 nm

The Multiple Application Platform (MAP) Light Emitting Diode (LED) Source Cassette is a high-power LED based light source with variable output power. High output power and excellent wavelength stability, combined with built in modulation circuitry, make this light source suitable for wavelength division multiplexing (WDM) component manufacturing and testing. Other applications of this device include sensing, spectroscopy and amplified spontaneous emissions (ASEs) loading for optical signal to noise ratio (OSNR) measurements.

Specifications

Single-mode (SM) Parameter	1310 nm	1550 nm
Peak wavelength	1310 ± 20 nm	1550 ± 20 nm
3 dB width	> 40 nm	> 40 nm
Spectral ripple (RB=0.1nm)	0.35 dB	0.35 dB
Total power[1,2]	0 dBm	0 dBm
Modulation	0.2 to 20 kHz	
Stability (15 minutes)[1,2,3]	± 0.01 dB	
Connector type	FC/PC, FC/APC	
Operating temperature	10 to 40 °C	
Storage temperature	- 30 to 60 °C	
Dimensions (W x H x D)	4.06 x 13.24 x 39.5 cm	
Weight	0.5 kg	

Multimode (MM) Parameter	850 nm	1310 nm	1550 nm
Peak wavelength	850 ± 20 nm	1310 ± 20 nm	1550 ± 20 nm
Total power[1,2]	-3 dBm	- 3 dBm	- 3 dBm
Modulation	0.2 to 20 kHz		
Stability (15 minutes)[1,2,3]	± 0.01 dB		
Connector type	FC/PC, FC/APC		
Operating temperature	10 to 40 °C		
Storage temperature	- 30 to 60 °C		
Dimensions (W x H x D)	4.06 x 13.24 x 39.5 cm		
Weight	0.5 kg		

1. After 30 minute warm-up.
2. Measured at constant temperature of 23 ± 5 °C.
3. Measured at full power.

Ordering Information

For more information on this or other products and their availability, please contact your local JDS Uniphase account manager or JDS Uniphase directly at 1-800-498-JDSU (5378) in North America and +800-5378-JDSU worldwide or via e-mail at sales@jdsu.com.

Sample : MAPB+1L057FP

MAPB+1L [0] [ ] [ ] [ ][ ]

Code	Output Power
0	Standard

Code	Wavelength (nm)
1	850
3	1310
5	1550
7	1310/1550
9	850/1310

Code	Fiber Type (μm)
1	50/125
2	62.5/125
7	9/125

Code	Connector Type
FP	FC/PC
FA	FC/APC

If the configurations available do not meet your performance requirements, please contact our global sales and customer service team to discuss the potential for specialized solutions.

MAP Tunable Laser

For stand-alone applications, the MAP Tunable Laser may be used as a benchtop

Key Features

- > 110 nm of tunable range over C+L-band
- > 6 dBm output power
- Coherence control
- Polarization maintaining fiber (PMF) output
- High speed tuning

Applications

- Dense wavelength division multiplexing (DWDM) transmission testing
- Optical amplifier testing
- Fiber characterization
- Transmitter and receiver testing

Safety Information

This optical source cassette, when installed in the MAP chassis, complies to CE requirements plus UL3101-1 and CAN/CSA-C22.2 No.1010.1, meets the requirements of Class 3B in standard IEC 60825-1(2002), and complies with 21 CFR 1040.1 except deviations per Laser Notice No.50, July 2001.

INVISIBLE LASER RADIATION
AVOID EXPOSURE TO BEAM
CLASS 3B LASER PRODUCT
(IEC 60825-1, 2002)
MAX. 500 mw, 700-1680 nm

The Multiple Application Platform (MAP) Tunable Laser Cassette is an external cavity tunable diode laser that offers exceptional speed, accuracy and flexibility at a competitive price, making it the ideal source for advanced fiberoptic systems and component testing.

The wide wavelength range enables testing over the entire C+L-band range with a single source, while its high speed, mode-hop-free sweeping not only reduces testing time, but permits process testing and alignment of components during manufacturing.

As with all MAP cassettes, it may be seamlessly integrated with the extensive family of MAP cassettes, which enables complete custom solutions to be rapidly assembled and expanded as needed.

Specifications

Parameter	Specification
Wavelength	
Range	1520 to 1630 nm, C+L-band
Accuracy[1,2,3]	± 15 pm enhanced accuracy mode[4], ± 60 pm regular mode
Stability[1,2]	± 5 pm (1 hour), ± 6 pm (24 hours)
Repeatability[1,2]	± 5 pm (1 hour) enhanced accuracy mode[4]
Resolution[1,2]	1 pm
Tuning speed	1 to 100 nm/s
Power	
Maximum power	
110 nm	0.8 dBm (> 2.0 dBm typical)
50 nm	3.0 dBm (> 5.0 dBm typical)
peak	6.0 dBm (typical)
Stability[1,2]	0.05 dBm (1 hour)
Repeatability	± 0.1 dB (1 hour)
Resolution	0.001 dB
Flatness while scanning	± 0.5 dB over 110 nm, ± 0.05 dB over 1 nm
Spectral properties	
Line width, coherence control off	< 150 kHz
Line width, coherence control on	> 120 and < 300 MHz
Side mode suppression ratio (SMSR)	45 dB
Amplified spontaneous emission (ASE) ratio	> 50 dB (Peak to max background), > 23 dB (Peak to integrated background)
Optical isolation[5]	60 dB
Relative intensity noise (RIN)	< 140 dB/Hz
Fiber/connector type	Polarization maintaining fiber (PMF)/APC connector
Fiber extinction ratio	> 20 dB
Recommended calibration period	1 year
Operating temperature	10 to 40 °C
Storage temperature	- 20 to 60 °C
Dimensions (W x H x D)	8.12 x 13.24 x 39.5 cm
Weight	4.5 kg

1. Measured at 25°C ±1 °C.
2. After 1 hour warm-up.
3. After calibration.
4. Fixed power of 0 dBm.
5. Measured at 1560 nm.

Ordering Information

For more information on this or other products and their availability, please contact your local JDS Uniphase account manager or JDS Uniphase directly at 1-800-498-JDSU (5378) in North America and +800-5378-JDSU worldwide or via e-mail at sales@jdsu.com.

Please use the part number below to order the MAP Tunable Laser.

MAPL+1T1FA

MAP Large Channel Count Switch

For stand-alone applications, the MAP Large Channel Count Switch may be used as a benchtop

Key Features

- Low IL < 0.7 dB
- Low polarization dependent loss (PDL) 0.04 dB
- Wide wavelength range
- High RL > 57 dB

Applications

- Dense wavelength division multiplexing (DWDM) channel testing
- Amplifier characterization
- Bit error rate (BER) testing
- Signal routing

Safety Information

This cassette, when installed in a MAP chassis, complies to CE requirements plus UL3101-1 and CAN/CSA-C22.2 No. 1010.1.

The Multiple Application Platform (MAP) Large Channel Count Switch Cassette is bidirectional and allows the connection of a common port to any number of channels up to 50. The cassette is available in single or dual-switch configurations.

The MAP switch cassette is based on JDS Uniphase expanded beam and alignment technologies and exhibits low insertion loss (IL) and high return loss (RL).

Specifications

Parameter[1]	Typical (Maximum) Single-mode fiber SMF 9/125	Typical (Maximum) Multimode fiber MMF 50/125 and 62.5/125
Wavelength range	1270 to 1670 nm	850 to 1350 nm, 750 to 940 nm
Insertion loss (IL)		
N < 25 (non-latching), N ≤ 22 (latching)	0.5 (0.7) dB	0.4 (0.6) dB
N > 25 (non-latching), N > 22 (latching)	0.8 (1.2) dB	0.7 (1.0) dB
Polarization dependent loss (PDL)[1]		
N ≤ 25 (non-latching), N ≤ 22 (latching)	0.02 (0.04) dB	N/A
N > 25 (non-latching), N > 22 (latching)	0.04 (0.08) dB	N/A
Return loss (RL)[2]		
N ≤ 25 (non-latching), N ≤ 22 (latching)	62 (57) dB	25 (20) dB
N > 25 (non-latching), N > 22 (latching)	55 (45) dB	20 (20) dB
IL Stability		
N ≤ 25 (non-latching), N ≤ 22 (latching)	± 0.02 (± 0.025) dB	
N > 25 (non-latching), N > 22 (latching)	±0.03 (± 0.04) dB	
Repeatability sequential switching		
N ≤ 25 (non-latching), N ≤ 22 (latching)	± 0.005 (± 0.01) dB	
N > 25 (non-latching), N > 22 (latching)	± 0.01 (± 0.03) dB	
Repeatability random switching		
N ≤ 25 (non-latching), N ≤ 22 (latching)	± 0.01 (± 0.05) dB	
N > 25 (non-latching), N > 22 (latching)	± 0.03 (± 0.08) dB	
Crosstalk		
N ≤ 25 (non-latching), N ≤ 22 (latching)	- 80 dB	N/A
N > 25 (non-latching), N > 22 (latching)	- 80 dB	N/A
Switching time (first channel/each additional channel)	25/15 ms	
Maximum input power (optical)	300 mW	
Lifetime	> 100 million cycles	
Operating temperature	- 5 to 55 °C	
Storage temperature	- 30 to 60 °C	
Dimensions (W x H x D)	4.06 x 13.24 x 39.5 cm	
Weight	1.3 kg maximum (varies with configuration)	

1. Excluding connectors. All optical measurements taken after temperature has been stabilized for one hour.
2. RL is based on 1 m pigtail (equivalent to bulkhead version).

Ordering Information

For more information on this or other products and their availability, please contact your local JDS Uniphase account manager or JDS Uniphase directly at 1-800-498-JDSU (5378) in North America and +800-5378-JDSU worldwide or via e-mail at sales@jdsu.com.

Sample: MAPS+1K17104L1FP

MAPS+1K □□ □□□□□ □□

Code	Fiber Type (µm)
17	50/125, 750 to 940 nm
18	50/125, 850 to 1310 nm
27	62.5/125, 750 to 940 nm
28	62.5/125, 850 to 1310 nm
70	9/125, 1270 to 1670 nm

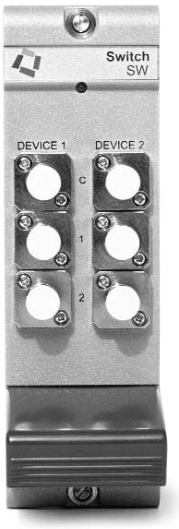
Code	Connector Type
FP	FC/PC
FA	FC/APC
SC	SC/PC
SU	SC/APC
LC	LC/PC

Code	Switch Configuration
1CCL1	Single switch, 1 x CC[1], latching, bulkheads
1CCN1	Single switch, 1 x CC[1], non-latching, bulkheads
1CCL3	Single switch, 1 x CC[2], latching, pigtail 2 m long
1CCN3	Single switch, 1 x CC[3], non-latching, pigtail 2 m long
204L1	Two switches, 1 x 4, latching, bulkheads
204N1	Two switches, 1 x 4, non-latching, bulkheads
2CCL3	Two switches, 1 x CC[4], latching, pigtail 2 m long
2CCN3	Two switches, 1 x CC[5], non-latching, pigtail 2 m long

1. Number of output channels (01 to 09)
2. Number of output channels (01 to 42)
3. Number of output channels (01 to 50)
4. Number of output channels (01 to 22)
5. Number of output channels (01 to 25)

If the configurations available do not meet your performance requirements, please contact our global sales and customer service team to discuss the potential for specialized solutions.

MAP Small Channel Count Switch



For stand-alone applications, the MAP Small Channel Count Switch may be used as a benchtop

Key Features

- Low insertion loss (IL) < 0.7 dB
- Low polarization dependent loss (PDL) 0.08 dB
- High return loss (RL) > 55 dB
- Up to 8 switches per cassette
- Available in latching or non-latching modes

Applications

- Dense wavelength division multiplexing (DWDM) channel testing
- Amplifier characterization
- Bit error rate (BER) testing
- Signal routing

Safety Information

This cassette, when installed in a MAP chassis, complies to CE requirements plus UL3101-1 and CAN/CSA-C22.2 No. 1010.1.

The Multiple Application Platform (MAP) Small Channel Count Switch is a single switch cassette that is able to accommodate a number of switches with varying channel counts and latching modes.

The switch redirects input light by an optical prism or mirror into a selected output channel. The switch is bidirectional, transparent to signal format, available in both single-mode (SM) and multimode (MM) versions, as well as latching or non-latching modes.

Special density and functionality cassettes can be made available on a custom order basis.

Continued

Selecting a Switch

To identify the appropriate switch selection, use the table below. Begin by choosing the appropriate switch configuration. Further narrow the choice by selecting a fiber type and a latching configuration. The number and letter, for example 8 (A), indicates the maximum switch density per cassette[1] and the applicable specification/ordering table respectively. The "code" column indicates the appropriate code in the Ordering Structure.

Configuration	Code	Latching	Non-latching	
		SM	SM	MM
1 x 2	2	8 (A)	-	-
1 x 3	3	-	2 (C)	2 (C)
1 x 4	4	-	2 (C)	2 (C)
1 x 5	5	-	2 (C)	2 (C)
1 x 6	6	-	2 (C)	2 (C)
1 x 7	7	-	2 (C)	2 (C)
1 x 8	8	-	2 (C)	2 (C)
2 x 2 crossover	A	8 (A)	-	-
2 x 4 D-config.[2]	B	-	2 (C)	2 (C)
2 x 6 D-config.[2]	C	-	2 (C)	2 (C)
2 x 8 D-config.[2]	D	-	2 (C)	2 (C)
1 x 2	T	-	4 (C)	4 (C)
2 x 2 crossover	X	-	2 (C)	2 (C)

1. Maximum switch density is achievable using pigtail exits. For bulkhead exit, maximum number of any type of switch is 3, up to a maximum of 10 bulkheads (common+outputs).
2. D-configuration refers to a synchronized parallel input channel alignment.

Specifications

Common Specifications Parameter	Specification
Operating temperature	0 to 50 °C
Storage temperature	- 30 to 60 °C
Humidity	90 % relative, non-condensing
Dimensions (W x H x D)	4.06 x 13.24 x 39.5 cm
Weight	1.1 kg maximum (varies with configuration)

Option A

Parameter	Specification
Insertion loss (IL)[1]	
1 x 2	0.8 dB
2 x 2	1.0 dB
Return loss (RL)[2]	55 dB
Polarization dependent loss (PDL)[2]	0.1 dB
Repeatability	± 0.05 dB
Crosstalk	- 60 dB
Optical input power	300 mW
Switching speed	8 ms

Option C

Parameter	Single-Mode (SM) Specification	Multimode (MM) Specification
IL[2]		
1 x 2, 2 x 2	<0.7 dB	<0.7 dB
1 x 3, 1 x 4, 2 x 4 "D"	< 0.9 dB	< 0.8 dB
1 x 5, 1 x 6, 1 x 7, 1 x 8, 2 x 6 "D", 2 x 8 "D"	< 1.05 dB	< 0.95 dB
RL (excludes connectors)		
selected port SM	> 55 dB	
selected port MM	> 30 dB	
PDL (SM only)		
1 x 2, 1 x 3, 1 x 4, 2 x 2, 2 x 4 "D"	< 0.08 dB	
1 x 5, 1 x 6, 1 x 7, 1 x 8, 2 x 6 "D", 2 x 8 "D"	< 0.10 dB	
IL stability[3]		
1 hour	± 0.02 dB	
24 hours	± 0.05 dB	
Repeatability[4]		
1 x 2, 1 x 3, 1 x 4, 2 x 2, 2 x 4 "D"	< 0.01 dB (p-p)	(± 0.005 dB)
1 x 5, 1 x 6, 1 x 7, 1 x 8, 2 x 6 "D", 2 x 8 "D"	< 0.02 dB (p-p)	(± 0.01 dB)
Crosstalk/isolation		
Selected port to other ports	< - 60 dB	< - 50 dB
non-selected to other non-selected (bi-directional)	< - 50 dB	< - 40 dB
Optical input power	300 mW maximum	
Lifetime	> 10 million cycles	
Switching time	< 20 ms	

1. Unless otherwise specified, all specifications at start of life at 23 °C ± 3 °C and 45 % RH ± 5 %. (not applicable to SQ cassette).
2. At 23 °C ± 3 °C at specified test wavelengths (850/1310 MM or 1310/1550 SM) and optical input power of - 25 to 0 dBm, excluding connectors. (not applicable to SQ cassette).
3. Drift of any channel at ± 3 °C deviation of ambient temperature without changing channels (excludes repeatability).
4. Repeatability as per Telcordia GR-1073-CORE (100 cycles, max-min/peak-to-peak).

Ordering Information

For more information on this or other products and their availability, please contact your local JDS Uniphase account manager or JDS Uniphase directly at 1-800-498-JDSU (5378) in North America and +800-5378-JDSU worldwide or via e-mail at sales@jdsu.com.

Ordering Structure for Option A
Sample: MAPS+2W73823FPL

MAPS+2W 7 3 ☐ ☐ ☐ ☐☐ L

Code	Fiber Type (µm)
73	9/125, 1310/1550 nm

Code	Number of Independent Switches
5	Five switch per cassette
6	Six switches per cassette
7	Seven switches per cassette
8	Eight switches per cassette

Code	Type of Switches
2	1 x 2
A	2 x 2

Code	Port Type
1	Bulkheads
3	Pigtails (2 m long)

Code	Connector Type (all ports)
NC	No connector (pigtail)
FP	FC/PC
FA	FC/APC
SC	SC/PC
SU	SC/APC
LC	LC/PC

Code	Latching
L	Latching

Ordering Structure for Option C
Sample: MAPS+2W16241FP

MAPS+2W ☐☐ ☐ ☐ ☐ ☐☐ ☐

Code	Fiber Type (µm)
15	50/125, 850 nm
16	50/125, 850/1310 nm
25	62.5/125, 850 nm
26	62.5/125, 850/1310 nm
73	9/125, 1310/1550 nm

Code	Number of Independent Switches
1	One switch per cassette
2	Two switches per cassette
3	Three switches per cassette
4	Four switches per cassette

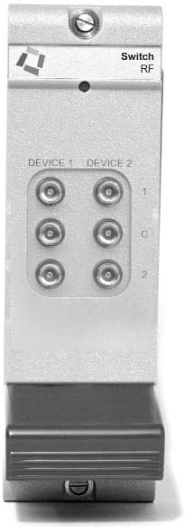
Code	Type of Switches
3	1 x 3
4	1 x 4
5	1 x 5
6	1 x 6
7	1 x 7
8	1 x 8
B	2 x 4 D-type
C	2 x 6 D-type
D	2 x 8 D-type
T	1 x 2
X	2 x 2

Code	Port Type
1	Bulkheads
3	Pigtails (2 m long)

Code	Connector Type (all ports)
NC	No connector (pigtail)
FP	FC/PC
FA	FC/APC
SC	SC/PC
SU	SC/APC
LC	LC/PC

Code	Latching
Blank	Non-latching

MAP RF Switch



For stand-alone applications, the MAP RF Switch may be used as a benchtop

Key Features

- Single or independent dual
- 1 x 2 and bypass versions
- Mechanically latching
- Built-in 50 Ohm terminations

Applications

- Data source selection
- Routing to main analyzer

Configurations

- Single 1 x 2, dual independent 1 x 2
- Single bypass, dual independent bypass

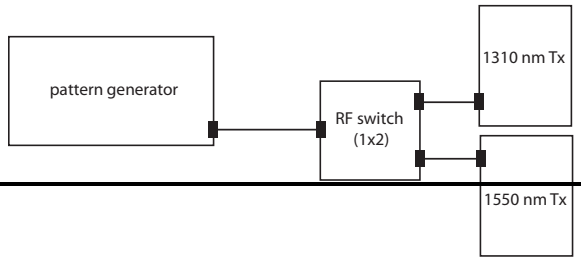
Safety Information

This cassette, when installed in a MAP chassis, complies to CE requirements plus UL3101-1 and CAN/CSA-C22.2 No. 1010.1.

The Multiple Application Platform (MAP) RF switch cassette is a 50 Ohm coaxial switch for routing RF and microwave signals at frequencies up to 26.5 GHz. Comprising of single and dual 1 x 2 and bypass-type switches, these cassettes are an ideal solution for routing 10 Gb signals between power meters, receivers, and spectrum analyzers. The switches are based on mechanical latching actuators with a million-cycle lifetime.

The single and independent dual 1 x 2 configurations units feature dual built-in 50 Ohm terminators for each of the unused ports, allowing efficient use as an A-or-B source selector.

The single and independent dual bypass switches feature a single built-in 50 Ohm termination on one of the 'insert' loop ports which is activated when switch is in the bypass [straight through] state.



MAP RF Switch Application

Specifications

Parameter	Specification
Frequency range	DC to 26.5 GHz
Insertion loss (IL)	0.25 dB: DC-2 GHz 0.50 dB: 2 to 18 GHz 1.25 dB: 18 to 26.5 GHz
IL repeatability	0.03 dB: DC-18 GHz 0.50 dB: 18 to 26.5 GHz
Isolation	90 dB: DC-18GHz 50 dB: 18 to 26.5GHz
SWR through line	< 1.15: DC-2 GHz < 1.25: 2 to 12.4 GHz < 1.40: 12.4 to 18 GHz < 1.80: 18 to 26.5 GHz
SWR into load	< 1.15: DC to 2 GHz < 1.25: 2 to 12.4 GHz < 1.30: 12.4 to 18 GHz < 1.80: 18 to 26.5 GHz
Connectors	3.5 mm female

Ordering Information

For more information on this or other products and their availability, please contact your local JDS Uniphase account manager or JDS Uniphase directly at 1-800-498-JDSU (5378) in North America and +800-5378-JDSU worldwide or via e-mail at sales@jdsu.com.

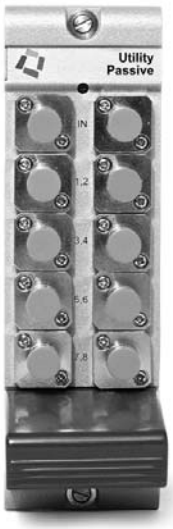
Sample: MAPS+1R112

MAPS+1R □ □□

Code	Number of Switches
1	1 switch
2	2 independent switches

Code	Type of Switch
12	1 x 2 switch
2B	Bypass
MX	1 x 2 and bypass

MAP Utility



For stand-alone applications, the MAP Utility may be used as a benchtop

Key Features

- Many tap ratios available
- Up to 3 couplers per cassette
- SM and MM

Applications

- Bit error rate (BER) test
- Passive component test
- Optical amplifier test

Safety Information

This cassette, when installed in a MAP chassis, complies to CE requirements plus UL3101-1 and CAN/CSA-C22.2 No. 1010.1.

The Multiple Application Platform (MAP) Utility Cassette is designed to simplify the mechanical integration of passive optical components for test sets. It is a highly configurable cassette that contains passive optical devices such as 1 x 4 splitters, 1 x 8 splitters and taps. It supports angle or flat polish connectors and single-mode (SM) and multimode (MM) fibers.

A blank cassette is available for mechanical mounting of components such as isolators, circulators or fixed attenuators. The cassettes are supplied with mounting hardware and up to ten bulkhead adapters for ease of integration.

Specifications

Parameter	Specification			
Single-mode (SM) splitters/couplers (fused)	**1 x 4 type**		**1 x 8 type**	
Fiber type	9/125 µm			
Wavelength	1310/1550 nm			
Insertion loss (IL)	8.0 dB		11.5 dB	
SM taps/couplers (fused)	**1/99 coupling ratio**	**10/90 coupling ratio**	**30/70 coupling ratio**	**50/50 coupling ratio**
Fiber type	9/125 µm			
Wavelength	1310/1550 nm			
IL	< 24.0/1.2 dB	< 11.8/<1.2 dB	< 6.5/< 2.4 dB	< 4.1 dB
Multimode (MM) taps/couplers (micro-optic)	**10/90 coupling ratio**		**50/50 coupling ratio**	
Fiber type	50/125 µm or 62.5/125 µm			
Wavelength	850/1310 nm			
IL	< 11.8/< 1.2 dB		< 4.1 dB	
General				
Optical power handling	300 mW			
Number of slots	1			
Dimensions (W x H x D)	4.06 x 13.24 x 39.5 cm			
Weight	< 1.0 kg			

Ordering Information

For more information on this or other products and their availability, please contact your local JDS Uniphase account manager or JDS Uniphase directly at 1-800-498-JDSU (5378) in North America and +800-5378-JDSU worldwide or via e-mail at sales@jdsu.com.

MAP Utility Cassette with Built-in Splitter/Coupler
Sample: MAPU +1SFP12103700

MAPU+1S □□ □□□□□□□ 0

Code	Connector Type
FP	FC/PC
FA	FC/APC
SC	SC/PC
SU	SC/APC

1 X 2 tap/coupler

1 2 □□ □ □□

Code	Tap Ratio
01	1/99 (9/125 only)
10	10/90
30	30/70 (9/125 only)
50	50/50

Code	Number of Devices
1	1
2	2
3	3

Code	Fiber Type (µm)
10	50/125 at 850/1310 nm (micro-optic)
20	62.5/125 at 850/1310 nm (micro-optic)
70	9/125 at 1310/1550 nm (fused)

1 X 4 tap/coupler

1 4 0 0 □ 7 0

Code	Number of Devices
1	1
2	2

1 X 8 splitter/coupler

1 8 0 0 1 7 0

Blank MAP Utility Cassette
Sample: MAPU +10FP04000000

MAPU+10 □□ □□ 0 0 0 0 0 0

Code	Connector Type
FP	FC/PC
FA	FC/APC
SC	SC/PC
SU	SC/APC

Code	Number of Bulkhead Connectors
01	1
02	2
03	3
04	4
05	5
06	6
07	7
08	8
09	9
10	10

Standard Accessories included with a blank MAP Utility Cassette: splice holders, fiber holders, coupler mounts.

If the configurations available do not meet your performance requirements, please contact our global sales and customer service team to discuss the potential for specialized solutions.

Switches

JDS Uniphase is a pioneer in fiberoptic switches and offers a diverse and innovative switch product line. The line includes 1 x N fiberoptic switch modules, benchtop and rackmount programmable switches, and M x N matrix switches that provide up to 32 x 32 channels of connectivity. The full product line is available in both multimode and single-mode, with specialty fiber variants developed on request. For special optical switching needs and specific test requirements, customized solutions are available in our SA Series Custom Switch Assembly.

The performance, configuration, and flexibility of JDS Uniphase switches make them suitable for a wide range of applications including fiberoptic component testing, remote fiber system testing in telecommunication networks, transmitter/receiver measurements, reconfiguration and restoration in broadband fiber telecommunication networks, and research and development. In a typical application, an optical switch enables increased throughput and parallel processing through simultaneous testing of multiple parameters of one or more devices without repeated physical reconnections. This substantially increases test equipment utilization and reduces test time, thereby reducing the cost of ownership of test equipment.

Switch operation is based on JDS Uniphase's proven expanded beam lens technology combined with one of several alignment technologies. These switches are unique in their operational stability, excellent repeatability, low insertion loss, and high reliability, which make them ideal for component and system testing.

At JDS Uniphase, we offer turnkey solutions for all your fiberoptic switch requirements.

Included in This Section

Switch Selection Guide

Bench-top / Rackmount Switches - SB, SC and SCG series

The SB, SC and SCG series of programmable opto-mechanical switches are designed to connect multiple fiber optic input channels to any of N output channels. In the SB series of switches, the number of input channels can go up to 2 and number of output channels up to 48. For the SC series, up to 4 input channels can be accommodated, with up to 90 outputs on a 3U SC and up to 180 outputs on a 6U SC. The SCG series of switches allows up to 45 input channels to be switches simultaneously (single command, no inter-channel lag-time) maintaining very low insertion loss and PDL. The unique design of the SCG switches allows replacement of multiple switching elements in a test and measurement set up with a single switching element while maintaining low losses.

All the switches in these series are available in there different configurations (D, E and F), making them the most flexible switch platform with superior performance in the market. The performance, configuration and customization flexibility, and portable enclosure of these switches are suitable for a wide range of applications, including fiber optic component and system testing, remote fiber sensing and monitoring, R&D measurements applications, and other specialty applications in telecommunications, military, and fiber sensing. These series of switches are well known in the market for their very high levels of repeatability and very low optical losses, making them ideal for repeatable precision device testing. Single-mode and multimode versions of the switches are available.

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2 X N Compact Matrix Switch Module - SMM series

The SMM series switch is a compact 2 x N matrix switches module utilizing newly-developed actuator mechanics. The unique design of this switch allows for a very small 2 x N matrix with up to 28 output ports with either full matrix or semi-matrix connection capability. Each SMM module is capable of housing two independent 2 x 28 optical matrix units, which can be custom-integrated with additional switching to build up larger 2 x N assemblies (N up to 120 channels) in a compact footprint. The SMM series of switches is the first compact matrix to offer very short and low-loss optical signal paths, absolute position encoders, and latching actuators capable of supporting both single-mode and multimode optics. The SMM modules are ideal for a wide range of sensing and monitoring applications, as well as matrix modules to be integrated into a custom portable test instrument.

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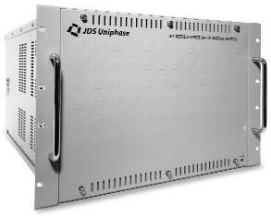

Programmable Matrix Switch and Reconfigurable Matrix Switch - SG and SGRM series

The SG and SGRM series of switches are flexible rackmountable cross-connect switches, based on the proven opto-mechanical switching technology of JDS Uniphase. True non-blocking optical matrix arrangement in these switches allows for unprecedented signal routing, with large channel counts (32 x 32 or 16 x 48) while maintaining very low losses during both power-on and power-off states (latching optics). Their extensive cross-connection capability makes them suitable for a broad range of applications, ranging from general-purpose testing in labs to automated multi-port optical device testing and characterization. The SG series provides a traditional M-input to N-output non-blocking connection capability, whereas the SGRM series of re-configurable matrix switches allows for virtually unlimited any-to-any port connection. Additionally, the SGRM can be user-configured to function as a traditional cross-connect matrix, minimizing test equipment duplication and expenditure. Al the switches in these series are available in Single-mode and multimode. Optional redundant/dual-line power supplies for special applications are also available.

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Switch Selection Guide

Ultra low loss Matrix Switch - Polatis Switch series

JDSU Uniphase is the worldwide distributor of the new ultra low loss matrix switch from Polatis Ltd. Polatis switch series is a range of fully non-blocking optical switch units based ion patented Micro-Actuation and Sensing System (MASS) technology. The switches ate available in both asymmetric and symmetric formats ranging from 4 to 32 in steps of 4. This series of switches are also available in reconfigurable, single-mode and multi-mode (up to 16 x 16 at present) versions. The ultra-low insertion loss, low PDL, fast switching speed, excellent repeatability, protocol and bit rate independent, dither free alignment and high security, makes this switch ideal for applications ranging from test and measurement, RF over fiber switching, automated patch panel, video distribution, captive office automation, high power laser source switching, etc. This series of switches is available in both 1U/2U tray and module formats.

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Large Channel Count Switch Module - SKB series

The SKB 1 x N controllable switch module controls up to four independent 1 x N optical switches, with configurations of up to 100 channels. Small and rugged, the switch is designed to be used in embedded applications. It is available in single-mode and multimode versions and has several features that reduce installation and support efforts. The switch offers low insertion loss, optional latching actuators, and is independent of data format and direction. The individual modules can be set up in configurations ranging from Quad 1 x 24 to Single 1 x 100, making them well-suited for RFTS installations, remote sensing and monitoring, medical research labs, and as OEM-type switches specified by system integrators. SKB series of switches have a lifetime of 120 million cycles.

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Small Channel Count Switch Module - SW series

The SW series in a very compact and easy-to-interface optical switch family that currently provides four types of single-actuator switches: 1 x 1, 1 x 2, 2 x 2 crossover, and 2 x 2 bypass. These compact switches - available in both single-mode and multimode fiber variants - are ideally suited as additional routing switches in support of larger testing and monitoring installations. Their small size and fast switching times make them an ideally simple and transparent solution for beam-blocking of transmitters/lasers, switching in and out passive elements such as attenuator pads or bandpass filters, or in setting up automated bidirectional testing (where only one source and one power meter are available, but device tests need to be done in two opposite directions).

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Rugged Small Channel Count Switch module- SR series

The SR series switches uses a simple yet very rugged actuating mechanism that is able to withstand use in a wide temperature range, and is, therefore, suited to seldom-accessed installations that may expose the unit to exceedingly cold temperatures. The single-actuator units are available in several optical configurations (1 x 1, 1 x 2, 2 x 2, dual 1 x 2, and dual 2 x 2) and in both single-mode and multimode fibers. They are very well suited to optical signal routing, fiber network configuration and restoration, as well as OEM-style installations as part of a portable test jig.

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Switch Selection Guide

Flexible Small Channel Count Switch module - SQ series

The SQ switch is ideal for applications requiring high optical performance in latching or non-latching applications. The full feature set and large number of optical configurations available in a common package and interface make it ideal for a wide spectrum of applications, ranging from OEM-style installations in portable and modular test sets, to remote sensing and monitoring installations. The units are available with up to 8 channels, with several variants available with dual inputs, all contained in one foot print. The SQ series of switches are the only units in the market having TTL and parallel compatible drive modes with no change in specifications. The SQ is also unique in that it is capable of being operated in either latching or non-latching modes, either being user-selectable with no DIP switches or reprogramming of the unit.

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Custom Switch Assembly - SA Series

The SA series of switch assemblies typically contain a combination of relay, precision stepper motor optical switches, splitters and attenuators. Direct-drive lines can be pre-configured to operate in groups, providing individual switch control. The SA unit is designed to connect fiber optic input channels to any of N output channels, in a wide variety of configurations. A unique, easy-to-use local and remote user interface provides simple control of the technology.

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Benchtop/Rackmount Programmable Switches

SB/SC/SCG Series

Applications

- Fiberoptic component testing and measurement
- System testing
- Research and development (R&D)
- Mass reconfiguration of large numbers of inputs/outputs with SCG series (D configuration)
- Connection of multiple wavelength sources to any one of a number of devices with SCG series (F configuration)
- Network monitoring

Safety Information

Complies to CE requirements plus UL3101-1 and CAN/CSA-C22.2 No. 1010.1

Key Features

SB and SC series

- SB series can accommodate up to 48 channels and offer up to two input channels
- SC series can accommodate up to 180 channels and offer up to four input channels
- Low IL, 0.4 dB typical
- Excellent repeatability, 0.003 dB typical
- High return loss (RL) > 65 dB typical
- GPIB and RS-232 remote control

SCG series

- Offer up to 45 input channels and 90 output channels
- Mass input reconfiguration possible
- Low IL, 0.5 dB typical for D configuration
- High RL, > 65 dB typical
- Excellent repeatability, 0.005 dB typical
- Replaces multiple switch elements with one switch instrument

The JDS Uniphase SB, SC, and SCG series of Benchtop/Rackmount Programmable Switches can be controlled using the front panel keys and a numeric pad or via GPIB and serial RS-232 interface. The SCG series ganged input switches allow a single switch instrument to replace multiple switch elements while maintaining low loss. In this series of switches, the inputs are ganged together in a particular sequence and are thus able to offer three different modes of operation.

The SB and SC series switches are available in four basic configurations:

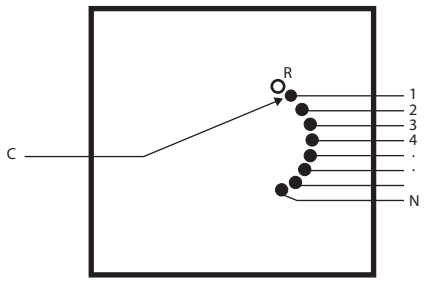
- C configuration - is a single common input model
- D configuration - provides simultaneous connection of a bank of input fibers to output fibers
- E configuration - allows any input to be connected to any output while other inputs/outputs are aligned to subsequent/adjacent channels. The switch is non-blocking in this mode and other inputs/outputs are aligned
- F configuration - enables one of the inputs to be aligned with an output in a blocking sense, with a result in reduction of available output channels and a low-loss M x N blocking switch.

Operation of these switches is based upon JDS Uniphase's proven expanded beam lens technology, which utilizes a precision stepper-motor to align optical channels. The use of collimating lenses minimizes insertion loss (IL) and improves repeatability and performance. Internal temperature control of the switching mechanism ensures excellent operational stability.

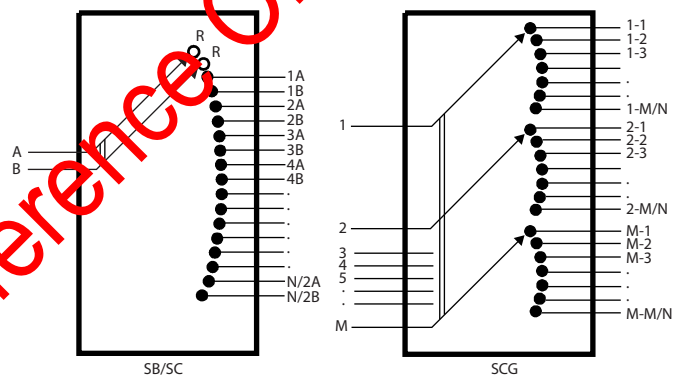
Continued

Both single-mode (SM) and multimode (MM) versions of the SB, SC, and SCG series switches are available. The series features the high level of performance required for multi-unit testing in R&D and in manufacturing environments. The compact, portable SB switch and the standard rackmount enclosure SC and SCG switches are highly suited for applications in telecommunications, manufacturing, and test environments.

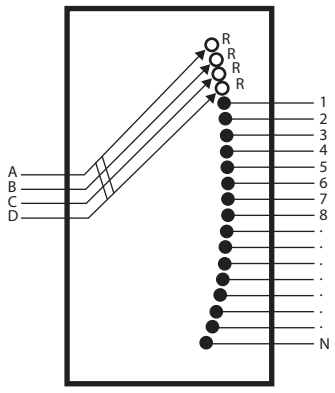
JDS Uniphase's SB and SC switches are known in the fiberoptic industry for their low IL and excellent repeatability. In addition to the many standard options available, we also customize switches in this series to meet your specific application needs.



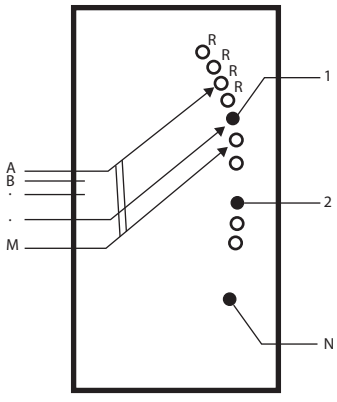
C Configuration (SB and SC)
The 1xN configuration allows a single common input to be switched to any of the outputs.



D Configuration (SB/SC/SCG)
The MxN configuration allows for mass reconfiguration of optical paths. It provides simultaneous connections of a bank of inputs to outputs.



E Configuration (SB/SC/SCG)
The MxN configuration aligns any input with any output, while other inputs are aligned to adjacent outputs.



F Configuration (SB/SC/SCG)
The MxN configuration allows any one of a bank of inputs to connect with any output with no other connections occurring.

Specifications - SB Model

Parameter[1]	Single Common C Configuration		Multiple Common D Configuration		Multiple Common E and F Configurations	
	Typical	Maximum	Typical	Maximum	Typical	Maximum
Insertion loss (IL)						
Single-mode (SM)	0.4 dB	0.7 dB	0.4 dB	0.7 dB	0.5 dB	1.0 dB
Multimode (MM)	0.4 dB	0.7 dB	0.4 dB	0.7 dB	0.5 dB	1.0 dB
Return loss (RL)[2]						
SM standard/analog	≥ 65 dB	60/65 dB	≥ 65 dB	60/65 dB[3]	65 dB	60 dB
MM[4] standard/analog	25/35 dB	20/30 dB	25/35 dB[3]	20/30 dB[3]	> 25 dB	20 dB
Polarization dependent loss (PDL) SM	0.02 dB	0.05 dB	0.02 dB	0.05 dB	0.03 dB	0.07 dB
IL stability[5]	± 0.03 dB	± 0.05 dB	± 0.03 dB	± 0.05 dB	± 0.03 dB	± 0.05 dB
Repeatability[6]						
sequential switching	± 0.003 dB	± 0.005 dB	± 0.005 dB	± 0.01 dB	± 0.005 dB	± 0.01 dB
random switching	± 0.01 dB	± 0.025 dB	± 0.02 dB	± 0.04 dB	± 0.02 dB	± 0.04 dB
Crosstalk (maximum) SM	- 80 dB					
Maximum input power (optical)	300 mW					
Lifetime	> 80 million cycles					
Switching time one channel	300 ms					
each additional channel	12 ms					
Power supply	100 to 240 V, 50 to 60 Hz					
Power consumption	100 V A maximum					
Control	local and remote via GPIB and serial RS-232 interfaces					
Drivers for external switch modules	four open collector drivers with maximum 100 mA sink current					
Operation temperature	0 to 55 °C					
Storage temperature	- 40 to 70 °C					
Humidity	maximum 95 % RH from 0 to 55 °C non-condensing					
Dimensions (W x H x D)	21.2 x 8.9 x 35.5 cm					
with rackmount kit (optional)[7]	48.3 x 8.9 x 35.5 cm					
Weight	3.75 kg					

1. Excluding connectors. All optical measurements taken after temperature has been stabilized for one hour, at ambient (room) conditions.
2. RL specification based on 1 m pigtail length.
3. Analog version available on one and two input SB model switches (C and D configurations).
4. Values shown for 62.5 µm diameter maximum fiber core.
5. Drift of any channel relative to reference channel at ± 3 °C deviation of ambient temperature over a seven-day period.
6. Measured between two consecutive readings over 100 cycles.
7. ED000899-A-00 standard rackmount kit, ED000899-A-01 Japan rackmount kit. Requires two kits to mount two units side-by-side. Please specify part number when ordering (if needed).

Specifications - SC and SCG Models

Parameter[1]	Single Common C Configuration (SC model only)		Multiple Common D Configuration		Multiple Common E and F Configurations	
	Typical	Maximum	Typical	Maximum	Typical	Maximum
IL						
SM	0.4 dB	0.7 dB	0.4 dB	0.7 dB	0.5 dB	1.0 dB
SC with 3 and 4 inputs and SCG models			0.5 dB	1.0 dB	0.7 dB	1.5 dB
MM	0.4 dB	0.7 dB	0.4 dB	0.7 dB	0.5 dB	1.0 dB
SC with 3 and 4 inputs and SCG models			0.5 dB	1.0 dB	0.7 dB	1.5 dB
RL[2]						
SM standard/analog	≥ 65 dB	60/65 dB	≥ 65 dB	60/65 dB[3]	≥ 65 dB	60 dB
MM[4] standard/analog	25/35 dB	20/30 dB	25/35 dB	20/30 dB[3]	> 25 dB	20 dB
PDL SM	0.02 dB	0.05 dB	0.02 dB	0.05 dB	0.03 dB	0.07 dB
IL stability[5]	± 0.03 dB	± 0.05 dB	± 0.03 dB	± 0.05 dB	± 0.03 dB	± 0.05 dB
Repeatability						
sequential switching	± 0.003 dB	± 0.005 dB	± 0.005 dB	± 0.01 dB	± 0.005 dB	± 0.01 dB
random switching	± 0.01 dB	± 0.025 dB	± 0.02 dB	± 0.04 dB	± 0.02 dB	± 0.04 dB
Crosstalk (maximum) SM	- 80 dB					
Maximum input power (optical)	300 mW					
Lifetime	> 80 million cycles (> 10 million cycles on SCG)					
Switching time						
one channel (SCG model)	300 ms (420 ms)					
each additional channel (SCG model)	12 ms (20 ms)					
Power supply	100 to 240 V, 50 to 60 Hz					
Power consumption	100 V A maximum					
Control	local and remote via GPIB and serial RS-232 interfaces					
Drivers for external switch modules	four open collector drivers with maximum 100 mA sink current					
Operation temperature	0 to 55 °C					
Storage temperature	- 40 to 70 °C					
Humidity	maximum 95 % RH from 0 to 55 °C non-condensing					
Dimensions (W x H x D) single (double height[6])	48 x 13 x 37 cm (48 x 26.6 x 37 cm) excluding handles					
Weight single (double height[6])	9 kg (14 kg)					

1. Excluding connectors. All optical measurements taken after temperature has been stabilized for one hour, at ambient (room) conditions.
2. RL specification based on 1 m pigtail length.
3. Analog version available on one and two input SC model switches (C and D configurations).
4. Values shown for 62.5 µm diameter maximum fiber core.
5. Drift of any channel relative to reference channel at ± 3 °C deviation of ambient temperature over a seven-day period.
6. Applies to SC model only.

The following table lists the current configurations that are supported for the SC switch. For information regarding other configurations, contact your JDS Uniphase representative.

SB/SC Switch Configuration

	C	D			E			F		
	1x N	2 x N	3 x N	4 x N	2 x N	3 x N	4 x N	2 x N	3 x N	4 x N
2U BENCHTOP	2 ⋮ 48	4 ⋮ 44	N/A	N/A	2 ⋮ 44	N/A	N/A	2 ⋮ 20	N/A	N/A
3U CHASSIS	49 ⋮ 84	46 ⋮ 84	45 ⋮ 84	44 ⋮ 80	45 ⋮ 84	45 ⋮ 84	45 ⋮ 84	21 ⋮ 44	13 ⋮ 26	11 ⋮ 20
6U CHASSIS	85 ⋮ 180	86 ⋮ 180	87 ⋮ 180	84 ⋮ 180	85 ⋮ 120	85 ⋮ 120	85 ⋮ 120	45 ⋮ 80	27 ⋮ 52	21 ⋮ 40

The following table lists configurations on the SCG switch. For information regarding other configurations, contact your JDS Uniphase representative.

SCG Switch Configuration

D Configuration							E Configuration	F Configuration			
6 x N	10 x N	16 x N	20 x N	26 x N	34 x N	45 x N	Up to 45x45, or 6x84	6 x N	8 x N	11 x N	13 x N
2 ⋮ 90	10 ⋮ 90	16 ⋮ 80	20 ⋮ 80	26 ⋮ 52	34	45	Contact JDSU for testing requirements	6 ⋮ 14	6 ⋮ 10	6 ⋮ 7	6
					68	90					

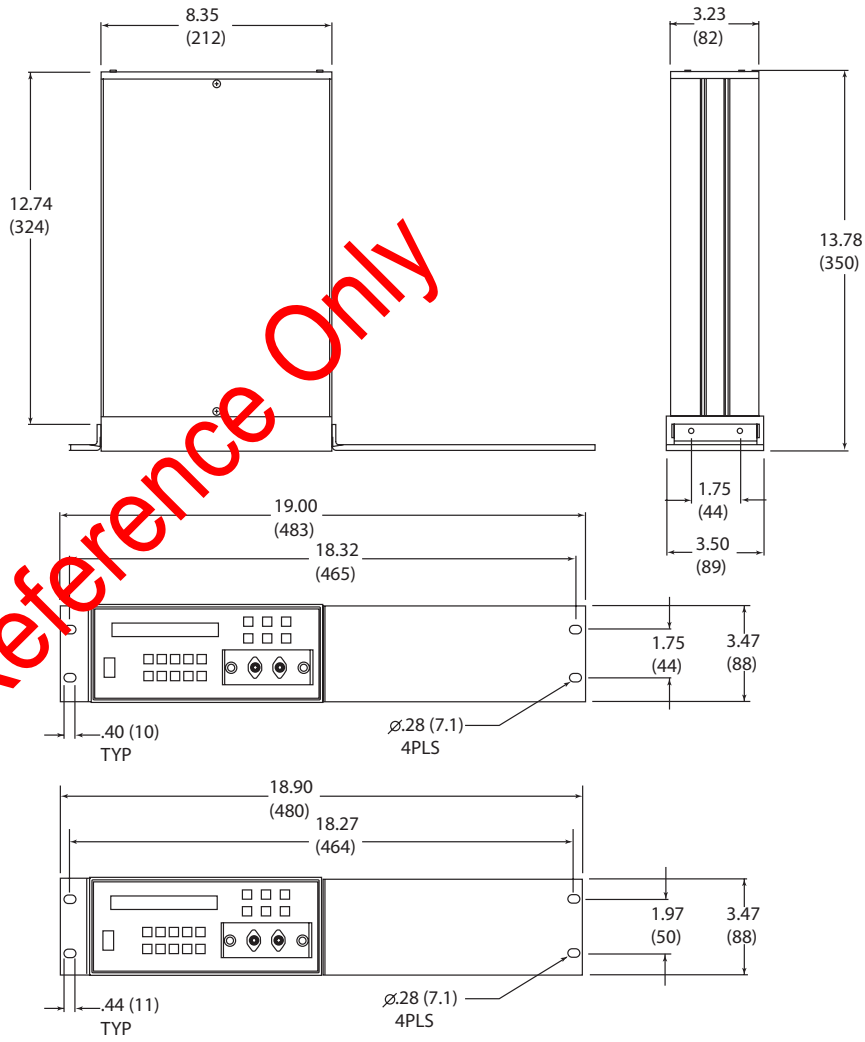
Configuration Restrictions

D: Up to 45 x 90 such that 'number of outputs' [N] is divisible by 'number of inputs' [M]

E: Up to 45 inputs [M] and up to 84 outputs [N], such that M + N is not more than 90

F: Up to 13 inputs [M] and up to 14 outputs [N], such that M x (N + 1) is not more than 93

Dimensions (SB Model)



Ordering Information - SB Model

For more information on this or other products and their availability, please contact your local JDS Uniphase account manager or JDS Uniphase directly at 1-800-498-JDSU (5378) in North America and +800-5378-JDSU worldwide or via e-mail at sales@jdsu.com.

Sample: SB2E10141+27XF000FP

SB ☐☐ ☐ ☐☐☐☐ +2 ☐☐ ☐ ☐☐☐ ☐☐

Code	Input Port Type[1]
1	Bulkheads on front
4	Pigtails on back

Code	Output Port Type[1]
1	Bulkheads on front
4	Pigtails on back

Code	Number of Input Channels
1C	1 input channel, C config.
2D	2 input channels, D config.
2E	2 input channels, E config.
2F	2 input channels, F config.

Code	Number of Output Channels
001	1 output channel
.	.
020	20 output channels
.	.
024	24 output channels
.	.
048	48 output channels

Code	Return Loss
X	Standard
A	Analog
B	Bidirectional, standard RL[2]
C	Bidirectional analog RL[2]

Code	Fiber Type (µm)
7	9/125
1	50/125
2	62.5/125
4	100/140

Code	Wavelength Range (nm)
F	1270 to 1670
Q	850 to 1350 (MM only)
B	750 to 940 (MM only)

Code	Connector Type
P	FC/PC (bulkhead maximum 24)
FA	FC/APC (bulkhead maximum 24)
SC	SC/PC (bulkhead maximum 24)
SU	SC/APC (bulkhead maximum 24)
NC	No connector

Code	Cable Length (3mm diameter)
001	1 m
003	3 m
009	9 m
000	Not applicable (bulkheads only)

1. Bulkheads and pigtails cannot be mixed in the same panel unless custom ordered.
2. For reverse direction, use bidirectional.

Bulkhead Limits

Bulkhead Type	Max Count (Including Commons)
FC/PC	24
FC/APC	24
SC/PC	24
SC/APC	24

If the configurations available do not meet your performance requirements, please contact our global sales and customer service team to discuss the potential for specialized solutions.

Ordering Information - SC Model

For more information on this or other products and their availability, please contact your local JDS Uniphase account manager or JDS Uniphase directly at 1-800-498-JDSU (5378) in North America and +800-5378-JDSU worldwide or via e-mail at sales@jdsu.com.

Sample: SC2D30043+22XB009FP

SC □□ □ □□□□ +2 □□ □ □□□ □□

Code	Input Port Type[1]
1	Bulkheads on front
2	Bulkheads on back
3	Pigtails on front
4	Pigtails on back

Code	Output Port Type[1]
1	Bulkheads on front
2	Bulkheads on back
3	Pigtails on front
4	Pigtails on back

Code	Return Loss
X	Standard
A	Analog
B	Bidirectional, standard RL[2]
C	Bidirectional analog RL[2]

Code	Connector Type
FP	FC/PC (bulkheads maximum 60/120)
FA	FC/APC (bulkheads maximum 60/120)
SC	SC/PC (bulkheads maximum 60/120)
SU	SC/APC (bulkheads maximum 60/120)
NC	No connector

Code	Number of Input Channels
1C	1 input channel, C config.
2D	2 input channels, D config.
2E	2 input channels, E config.
2F	2 input channels, F config.
3D	3 input channels, D config.
3E	3 input channels, E config.
3F	3 input channels, F config.
4D	4 input channels, D config.
4E	4 input channels, E config.
4F	4 input channels, F config.

Code	Number of Output Channels[2]
001	1 output channel
. .	
084	84 output channels
. .	
180	180 output channels

Code	Fiber Type (µm)
7	9/125
1	50/125
2	62.5/125
4	100/140

Code	Cable Length (3mm diameter)
001	1 m
003	3 m
009	9 m
000	Not applicable (bulkheads only)

Code	Wavelength Range (nm)
F	1270 to1670
Q	850 to 1350 (MM only)
B	750 to 940 (MM only)

1. Bulkheads and pigtails cannot be mixed in the same panel unless custom ordered.
2. Single height: 84 output channel maximum. Double height: 180 output channel maximum.
3. For reverse direction, use bidirectional.

Bulkhead Limits

Bulkhead Type	Max Count (Including Commons)	
	3U	6U
FC/PC	60	120
FC/APC	60	120
SC/PC	60	120
SC/APC	60	120

If the configurations available do not meet your performance requirements, please contact our global sales and customer service team to discuss the potential for specialized solutions.

Ordering Information - SCG Model

For more information on this or other products and their availability, please contact your local JDS Uniphase account manager or JDS Uniphase directly at 1-800-498-JDSU (5378) in North America and +800-5378-JDSU worldwide or via e-mail at sales@jdsu.com.

Sample: SCG06D20241+27XF000FP

SCG □□ □ □ □□□ □ + 2 □□ □ □□□ □□

Code	Configuration
D	D configuration
E	E configuration
F	F configuration

Code	Number of Output Channels[2]
05	5 input channels
.	.
08	8 input channels
.	.
16	16 input channels
.	.
45	45 input channels

Code	Number of Output Channels[2]
005	5 output channels
.	.
048	48 output channels
.	.
072	72 output channels
.	.
090	90 output channels

Code	Output Port Type[1]
1	Bulkheads on front[2]
2	Bulkheads on back[2]
4	Pigtails on back

Code	Input Port Type[1]
1	Bulkheads on front[2]
2	Bulkheads on back[2]
4	Pigtails on back

Code	Fiber Type (µm)
7	9/125
1	50/125
2	62.5/125
4	100/140

Code	Return Loss
X	Standard
B	Bidirectional, standard RL[3]

Code	Wavelength Range (nm)
F	1270 to 1670
Q	850 to 1350 (MM only)
B	750 to 940 (MM only)

Code	Cable Length (3mm diameter)
001	1 m
003	3 m
009	9 m
000	Not applicable (bulkheads only)

Code	Connector Type
FP	FC/PC (maximum 60)
FA	FC/APC (maximum 60)
SC	SC/PC (maximum 60)
SU	SC/APC (maximum 60)
NC	No connector

1. The inputs and outputs must exit on opposite sides. (For example, if inputs exit from the front, then the outputs must exit from the rear.)
2. For exact layout of bulkheads and labeling, contact JDS Uniphase.
3. For reverse direction, use bidirectional.

Bulkhead Limits

Bulkhead Type	Max Count (Including Commons)
FC/PC	60
FC/APC	60
SC/PC	60
SC/APC	60

If the configurations available do not meet your performance requirements, please contact our global sales and customer service team to discuss the potential for specialized solutions.

2 x N Compact Switch Matrix Module

SMM Series

Key Features

- High optical performance
- High repeatability
- Latching
- Absolute position feedback
- Off position (optional)
- Status feedback
- Compact size
- Semi-blocking for lower insertion loss IL and cross-connect limitations

Special Options

- Fully non-blocking for unlimited cross connection functionality (signal may be interrupted on both outputs while switching)

Applications

- OEM Applications
- Incorporation into customized switch assemblies
- Network monitoring and testing
- Sensor switching
- Source/detection selection
- Research and development (R&D)

Configurations

- 2 x 4, 2 x 8, 2 x 12, 2 x 16, 2 x 20, 2 x 24
- Dual configuration (2 of 2 X N's in one module)
- Single-mode (SM) or Multimode (MM) fiber
- 900 µm buffered fiber
- Semi-blocking (standard) or non-blocking (special option)

The SMM series fiberoptic matrix switch is ideal for applications requiring an optically passive switch (transparent to signal format) providing high optical performance and bidirectional signal capability in a small form factor. The switch is latching with absolute position feedback.

The full feature set makes it ideal for a wide spectrum of applications.

The switch connects to two common channels to any of the N (up to 24) output channels in a non-blocking manner. Both single-mode (SM) and multimode (MM) versions are available by special order.

The operation of the switch is based on proven JDS Uniphase expanded beam lens technology utilizing precision stepper motors to align optical channels. The use of collimating lenses minimizes insertion loss (IL). The design is optimized for high return loss (RL).

The switch is microprocessor controlled via an addressable serial interface (RS-485), and is designed for mounting on a printed circuit board or within a module.

Safety Information

- Complies with GR-1073

Specifications

Parameter[1,2]	Specification
Insertion loss (IL)	< 1.0 dB max semi-blocking < 1.5 dB max fully non-blocking (contact factory for option)
Return loss (RL)[3]	> 55 dB
Polarization dependent loss (PDL)	< 0.1 dB
IL stability (24 hours)[4]	< ± 0.06 dB
Change in IL during power on/off cycle	< ± 0.1 dB
Crosstalk (maximum)	- 70 dB
Maximum input power (optical)	300 mW continuous
Switching time (first channel/each additional channel)	25/15 ms
Lifetime	> 10 million switching cycles
Interface	serial interface (RS-485)
Operating voltage	12 ± 0.6 V DC
Power consumption	10W maximum
Operating temperature	- 35 °C to 75 °C
Storage temperature	- 40 °C to 85 °C
Humidity	maximum 95 % RH from - 35 °C to 75 °C, non-condensing
Dimensions (W x H x D)	127.0 x 50.8 x 203.2 mm/5 x 2 x 8 inches
Weight	1.3 kg

1. All specifications referenced without connectors.
2. All optical measurements taken after temperature has been stabilized for one hour.
3. Return loss specification based on 1 m pigtail length.
4. Drift of any channel relative to reference channel at ± 3 °C deviation of ambient temperature over 24-hour period.

Ordering Information

For more information on this or other products and their availability, please contact your local JDS Uniphase account manager or JDS Uniphase directly at 1-800-498-JDSU (5378) in North America and +800-5378-JDSU worldwide or via e-mail at sales@jdsu.com.

Sample: SMM12C024S+1A7F2FSU

SMM □ 2 □□□□S + 1A7F □F□□

Code	Number of Independent Switches
1	1 switch
2	2 switches

Code	Optional Testing
C	Standard (forward) 2 X N
B	Bidirectional

Code	Number of Output Channels (Per Independent Switch)
003	3 output channels
...	...
024	24 output channels

Code	Features
S	Semi-blocking

Code	Voltage and Data Interface
A	12 V with DB9 connector

Code	Fiber Type
7	9/125

Code	Wavelength Range (nm)
F	1270 to 1670

Code	Pigtail Type
1	1 m
2	2 m
3	3 m

Code	Pigtail Type
F	0.9 mm tight buffer fiber

Code	Connector Type
FP	FC /PC
FA	FC/APC
SC	SC/PC
SU	SC/APC
LC	LC/PC
NC	no connector

Programmable Matrix Switch and Reconfigurable Matrix Switch

SG and SGRM Series

Key Features of SG Series

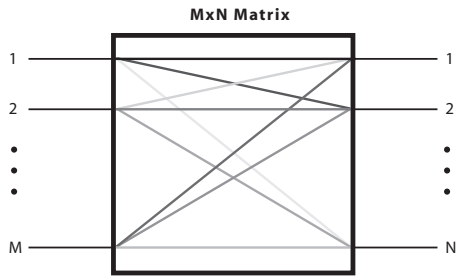
- Up to 64 total inputs and outputs (32 x 32, 28 x 36, etc.)
- Latching optical connections
- Low IL over operating range
- Broad wavelength operation
- High reliability
- RS-232 and GPIB remote control
- Local keypad control on 3U chassis

Applications of SG series

- Reconfiguration and restoration of broadband fiber networks
- Data communication and multimedia networks
- Research and development (R&D)

Safety Information

Complies to CE requirements plus UL3101-1 and CAN/CSA-C22.2 No. 1010.1



SG Switch Configuration

Programmable Matrix Switch - SG Series

The JDS Uniphase Programmable Matrix Switch is a non-blocking, compact, rackmountable instrument providing reliable switching operations. The design allows the user to connect any input to any output without breaking other existing connections. Standard asymmetrical (4 x 8, 8 x 12, up to 28 x 36) and symmetrical (8 x 8, 16 x 16, up to 32 x 32) configurations are offered for a broad range of applications in standard single-mode (SM) and multimode (MM) fibers.

The operation of the matrix switch is based on the proven expanded beam technology, utilizing precision stepper-motors to align optical channels. This feature results in excellent repeatability and stability. The use of collimating lenses minimizes insertion loss (IL) and enhances performance of the switches.

Optical signal stability over time is assured through the latching feature. Connections within the matrix switch change no more than 1 dB if there is a power interruption. At power up, the switch does not reconfigure until commanded to do so.

For reliability, two power supply options are available. A highly reliable integrated module is standard. As an option, a dual redundant, hot-swappable power supply is available as a separate rackmounted addition. Other options include an installation kit with rack slide set and rack extenders for a 24 inch (60.96 cm) rack.

Control of the device can be implemented remotely via a GPIB or an RS-232 interface. A LabVIEW driver is provided in order to control and monitor connection "status and switch" operations.

Key Features of SGRM Series

- Up to 48 ports with broad wavelength operation
- Protocol-independent all-optical signal path
- True non-blocking any-port-to-any-port connectivity
- Instrumentation-grade optics
- Latching operation
- Remote GPIB/RS-232 control
- Local keypad control on 3U chassis

Applications of SGRM series

- Transceiver testing racks
- Reconfiguration of fiber networks
- Research and development (R&D) labs

Safety Information

Complies to CE requirements plus UL3101-1 and CAN/CSA-C22.2 No. 1010.1

Configurations

- Up to 16 ports in 3U chassis, functions as 2 x 14 to 8 x 8
- Up to 32 ports in 7U chassis, functions as 2 x 30 to 16 x 16
- Up to 48 ports in 14U chassis, functions as 2 x 46 to 24 x 24

Reconfigurable Matrix Switch - SGRM Series

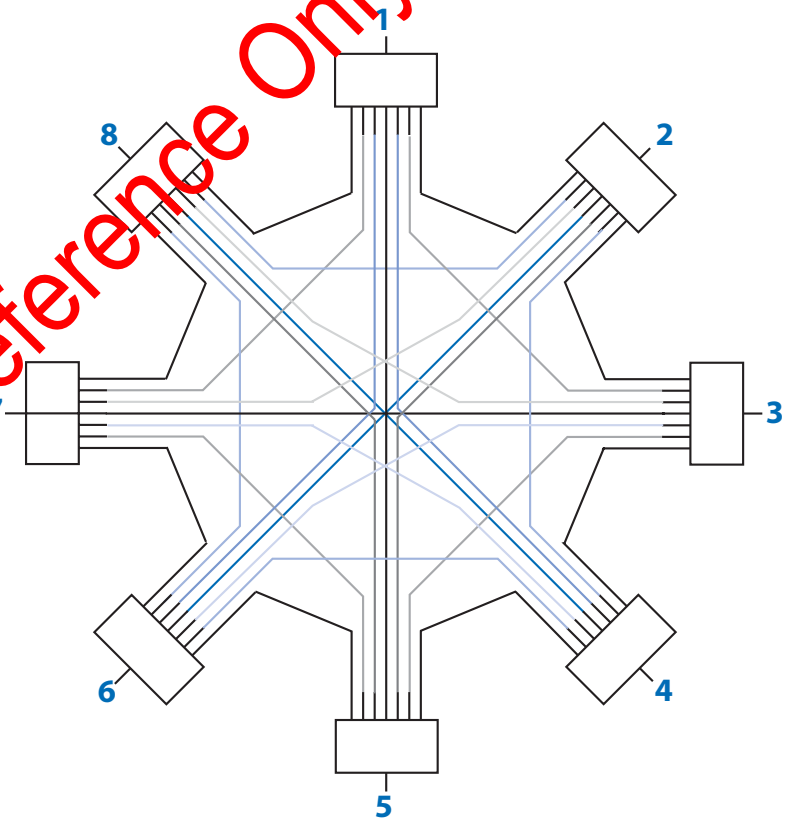
The SGRM series optical matrix switch is ideal for applications in which a traditional M x N port split is either unknown or may change as the system changes. In traditional switches, the number of input ports and number of output ports are known and fixed, and the resulting connectivity is of an "input port" to "output port" nature. In the SGRM series switch, the only variable is the total number of ports, which can then be dynamically allocated as input ports or output ports or as combination input/output ports (such as a transceiver). This architecture allows for a 16-port switch to function as any of a number of matrices, ranging from a 2 x 14 matrix up to an 8 x 8 matrix with no hardware or electrical changes.

The SGRM reconfigurable matrix switch is built using instrumentation-grade stepper-motors for high optical performance and long-term stability. Units are rackmountable with latching optics, direct front-panel keypad control (on 3U only), as well as remote GPIB/RS-232 interface ports. The SGRM is available in sizes up to 48 channels in standard 3U, 7U and 14U chassis.

Continued

Sample SGRM Configuration

Any single port (1-8) can connect to any other port directly. For example, used as a 2 x 6 matrix, ports 1 and 2 can be thought of as 'inputs', with ports 3 to 8 as 'outputs'. However, a connection from port 1 to port 2 (both 'inputs' in the example) is still possible at all times. Thus, using an N-port SGRM switch does not require any type of reprogramming or rearrangement to switch from use as a 2 x M or A x B. The transition is seamless.



8-Port Matrix Configuration

Specifications

Parameter[1]	Typical	Maximum
Insertion loss (IL)[2]		
Single-mode (SM)	1.0 dB	1.8 dB
Multimode (MM)	1.0 dB	1.8 dB
Return loss (RL)[3]		
SM	60 dB	55 dB
MM	25 dB	20 dB
Polarization dependent loss (PDL) SM	0.03 dB	0.07 dB
IL stability	± 0.1 dB	± 0.2 dB
IL change on power off	0.5 dB	1.0 dB
Repeatability[4]	± 0.04 dB	± 0.05 dB
Crosstalk (maximum) SM	- 80 dB	
Input power (optical)	300 mW continuous	
Lifetime	>10 million cycles	
Switching time single-channel increments	120 ms	
average connection	225 ms	
Input power consumption	500 V A maximum	
Operating power	100 to 240 V AC, 50 to 60 Hz	
Control	remote via GPIB and RS-232 interfaces	
Operating temperature	0 to 50 °C	
Storage temperature	- 40 to 70 °C	
Humidity	maximum 95 % RH from 0 to 50 °C non-condensing	
Dimensions (W x H x D)		
3U (19-inch rackmount)	48 x 13 x 38 cm	
7U (19-inch rackmount)	48 x 31 x 61 cm	
14U (19-inch rackmount)	48 x 62 x 61 cm	
Weight	15 kg (3U), 45 kg (7U), 75 kg (14U)	

1. All optical measurements taken after temperature has been stabilized for one hour, at ambient (room) conditions.
2. All specifications referenced without connectors.
3. RL specifications based on 1 m pigtail length.
4. Measured between two consecutive readings over 100 cycles.

Ordering Information

For more information on this or other products and their availability, please contact your local JDS Uniphase account manager or JDS Uniphase directly at 1-800-498-JDSU (5378) in North America and +800-5378-JDSU worldwide or via e-mail at sales@jdsu.com.

Sample: SG07142+27F000SC

SG □□ □□ □ +2 □ □ □□□ □□

Code	Number of Ports
02	2 channels
.	.
16	16 channels
.	.
48	48 channels
RM	Reconfigurable

Code	Number of Ports
02	2 channels
.	.
16	16 channels
.	.
48	48 channels

Code	In/Output Port Type[1]
1	Bulkheads on front (3U chassis only)
2	Bulkheads on back
3	Pigtails on front (3U chassis only)
4	Pigtails on back (3 mm cable)

1. 3 U height up to 8 x 8 ports.
   7 U height up to 16 x 16 ports.
   14 U height up to 32 x 32 ports.

Code	Fiber Type (µm)
7	9/125
1	50/125
2	62.5/125
4	100/140

Code	Wavelength Range (nm)
F	1270 to 167[illegible]
Q	8[illegible]0 to 1360 (MM only)
B	750 to 9[illegible] (MM only)

Code	Cable Length (3mm diameter)
001	1 m
003	3 m
005	5 m
009	9 m
000	Not applicable (bulkheads only)

Code	Connector Type
FP	FC/PC
FA	FC/APC
SC	SC/PC
SU	SC/APC
NC	No connector

If the configurations available do not meet your performance requirements, please contact our global sales and customer service team to discuss the potential for specialized solutions.

polatis

Optical Switch Module

OSM

Optical Switch Module OSM

The Polatis OSM family is a range of fully non-blocking optical switch modules designed for OEM integration. Excellent repeatability and optical performance are achieved for both single mode and multimode fibre variants using Polatis direct beam steering technology.

Switches are available in both symmetric (NxN) and asymmetric (NxM) formats, with (N and M) fibre counts ranging from 4 through to 32 in increments of 4 for single mode products. Multimode switches are currently available with fibre counts up to 16x16.

Polatis also offer Reconfigurable switch modules, allowing the user to create any matrix shape within the total fibre count. Reconfigurable switch dimensions currently range from 8 through to 32 fibers.

The modules are supplied in a compact package incorporating all required drive and control electronics.

Technology Platform

The Polatis photonic switches are based on patented Micro-Actuation and Sensing System (MASS) technology.

All Polatis switches provide ultra-low loss connections through a direct beam steering architecture that points input and output fibers at each other.

KEY FEATURES

- Ultra-low insertion loss
- Low Polarisation Dependent Loss
- Fast switching speed
- Excellent repeatability
- High power handling
- Operates with dark or lit fibre
- Fully non-blocking
- Bi-directional operation
- Protocol and bit rate independent
- Easy to integrate
- 5V, 12V operation
- High Speed Parallel or RS232 interface
- Simple control protocol
- Multimode fibre options
- Reconfigurable switch variants

APPLICATIONS

- OEM system integration
- Hybrid OO/OEO switches
- ROADM
- Optical bypass
- Fibre switching
- Protection switching
- Instrumentation grade switching
- Test and measurement
- RF over fibre
- Secure networks
- Automated optical component test
- High power laser source switching
- Reconfigurable patch panels

High performance optical switch solutions

PERFORMANCE SPECIFICATIONS

Single Mode Fibre	C[1]	D[1]
Insertion Loss @ 1550nm	<1.0dB[4]	<1.3dB[2,4]
Repeatability[3]	<0.1dB	
Wavelength Dependent Loss (1260-1675nm)	<0.3dB	
Polarisation Dependent Loss	<0.05dB	<0.1dB
Return Loss	>55dB	
Crosstalk	<-70dB	<-60dB
Switching Time[2]	<15ms	
Multimode Fibre	C[1,6]	
Fibre Type	50/125µm	62.5/125µm
Insertion Loss @ 1310nm	<1.7dB	<2.0dB
Insertion Loss @ 850nm	<2.2dB	<2.5dB
Repeatability	<0.1dB	
Return Loss	>40dB	
Crosstalk	<-50dB	
Switching Time[2]	<15ms	
Environmental		
Maximum Optical Power[5]	+27dBm	
Switch Lifetime	10^8 Cycles	
Operating Temperature (Normal Environment)	+5 to +45°C <85% RH non-condensing	
Operating Temperature (Extended Environment)	-10 to +60°C <90% RH non-condensing	
Storage Temperature (Normal Environment)	-40 to +70°C <40% RH non-condensing	
Storage Temperature (Extended Environment)	-40 to +70°C <95% RH non-condensing	
Qualification (Normal Environment)	Designed to meet EN60950	
Qualification (Extended Environment)	Designed to meet Telcordia GR1073, EN60950	

[1] All parameters are measured excluding connectors at 1550nm and 20°C with an unpolarised source after thermal equalisation unless stated
[2] 90% less than specified value and no value more than 10% greater than specified
[3] Measured as per Telcordia GR-1073 CORE section 4.2.11
[4] Measured using 3 patch-cord method as defined in TIA/EIA-526-14A
[5] Switch will operate on dark fibre
[6] Multimode switches available up to fibre counts of 16x16

FOR MORE INFORMATION

For more information on this or other products and their availability, please contact your local JDSU Uniphase account manager or JDS Uniphase directly at 1-800-498-JDSU (5378) in North America and +800-5378-JDSU worldwide or via e-mail at sales@jdsu.com.

Fibre Count	04	08	12	16	20	24	28	32
04	C	C	C	C	D	D	D	D
08	C	C	C	C	D	D	D	D
12	C	C	C	C	D	D	D	D
16	C	C	C	C	D	D	D	D
20	D	D	D	D	D	D	D	D
24	D	D	D	D	D	D	D	D
28	D	D	D	D	D	D	D	D
32	D	D	D	D	D	D	D	D
CC*	D	D	D	D	D	D	D	D

*CC = Reconfigurable

Packaging Information

Fibre Count Total	Environmental	Module Dimensions (mm)			Power Dissipation
4-32	Normal	280	189	57	15W
	Extended	260	169	38	
36-64	Normal	310	230	120	30W
	Extended	285	300	110	

Ordering Information

The product numbering scheme is as follows:

OSM-□□K□□□□□□-□□D□□

Ports
4-32 Input
8-32 Reconfigurable
Ports
4-32 Output
CC = Reconfigurable
Connector
L = LC
F = FC
SC = SC
T = ST
Polish
U = UPC
P = PC
A = APC
Fibre
1 = Single mode 9/125µm
8 = Multimode 50/125µm graded index 0.20NA
9 = Multimode 62.5/125µm graded index 0.28NA
Interface
R = RS232
P = Parallel & RS232
Protocol
S = SCPI
C = Command Line Interface
Voltage
D = DC
Environmental
N = Normal
E = Extended
Customisation
S = Standard
V = Non-Standard Variant

polatis

Optical Switch Tray
OST

Optical Switch Tray OST

The Polatis OST family is a range of fully non-blocking optical switch units designed for 19" ANSI and ETSI rack equipment practice. Excellent repeatability and optical performance are achieved for both single mode and multimode fibre variants using Polatis direct beam steering technology.

Switches are available in both symmetric (NxN) and asymmetric (NxM) formats, with (N and M) fibre counts ranging from 4 through to 32 in increments of 4 for single mode products. Multimode switches are currently available with fibre counts up to 16x16.

Polatis also offer Reconfigurable switch trays, allowing the user to create any matrix shape within the total fibre count. Reconfigurable switch dimensions currently range from 8 through to 32 fibers.

Integrated variable attenuation and optical power monitoring options are also available.

Technology Platform

The Polatis photonic switches are based on patented Micro-Actuation and Sensing System (MASS) technology.

All Polatis switches provide ultra-low loss connections through a direct beam steering architecture that points input and output fibers at each other.

KEY FEATURES

- Ultra-low insertion loss
- Low Polarisation Dependent Loss
- Fast switching speed
- Excellent repeatability
- High power handling
- Operates with dark or lit fibre
- Fully non-blocking
- Bi-directional operation
- Protocol and bit rate independent
- Easy to integrate
- Ethernet, RS232 or GPIB interface
- Simple control protocol
- Plug and Play operation
- Multimode fibre options
- Reconfigurable switch variants

APPLICATIONS

- Optical network reconfiguration
- Hybrid OO/OEO switches
- Optical bypass
- Fibre switching
- Protection switching
- Instrumentation grade switching
- Test and measurement
- RF over fibre
- Secure networks
- Automated optical component test
- High power laser source switching
- Reconfigurable patch panels
- Video distribution

High performance optical switch solutions

PERFORMANCE SPECIFICATIONS

Single Mode Fibre	G[1]	H[1]
Insertion Loss @ 1550nm	<1.0dB[4]	<1.3dB[2,4]
Repeatability[3]	<0.1dB	
Wavelength Dependent Loss (1260-1675nm)	<0.3dB	
Polarisation Dependent Loss	<0.05dB	<0.1dB
Return Loss	>55dB	
Crosstalk	<-70dB	<-60dB
Switching Time[2]	<15ms	
Multimode Fibre	G[1,6]	
Fibre Type	50/125µm	62.5/125µm
Insertion Loss @ 1310nm	<1.7dB	<2.0dB
Insertion Loss @ 850nm	<2.2dB	<2.5dB
Repeatability	<0.1dB	
Return Loss	>40dB	
Crosstalk	<-50dB	
Switching Time[2]	<15ms	
Environmental		
Maximum Optical Power[5]	+27dBm	
Switch Lifetime	10^8 Cycles	
Operating Temperature (Normal Environment)	+10 to +40°C <85% RH non-condensing	
Operating Temperature (Extended Environment)	-5 to +55°C <90% RH non-condensing	
Storage Temperature (Normal Environment)	-40 to +70°C <40% RH non-condensing	
Storage Temperature (Extended Environment)	-40 to +70°C <95% RH non-condensing	
Qualification (Normal Environment)	Designed to meet EN60950	
Qualification (Extended Environment)	Designed to meet Telcordia GR63 & GR1073, EN60950	

[1] All parameters are measured excluding connectors at 1550nm and 20°C with an unpolarised source after thermal equalisation unless stated
[2] 90% less than specified value and no value more than 10% greater than specified
[3] Measured as per Telcordia GR-1073 CORE section 4.2.11
[4] Measured using 3 patch-cord method as defined in TIA/EIA-526-14A
[5] Switch will operate on dark fibre
[6] Multimode options available up to fibre counts of 16x16

Fibre Count	04	08	12	16	20	24	28	32
04	G	G	G	G	H	H	H	H
08	G	G	G	G	H	H	H	H
12	G	G	G	G	H	H	H	H
16	G	G	G	G	H	H	H	H
20	H	H	H	H	H	H	H	H
24	H	H	H	H	H	H	H	H
28	H	H	H	H	H	H	H	H
32	H	H	H	H	H	H	H	H
CC*	H	H	H	H	H	H	H	H

*CC = Reconfigurable

Packaging Information

Fibre Count Total	Options	Tray Dimensions	Power Dissipation
4-32	Extended Environment, LC Connectors, Ethernet & RS232	19" rack mount, 1U high	25W
	FC, SC or ST Connectors		
	GPIB, Ethernet & RS232 Normal Environment	19" rack mount, 2U high	
36-64		19" rack mount, 3U high	50W

Ordering Information

The product numbering scheme is as follows:

OSI-□□x□□-□□□-□S□□□

Ports
4-32 Input
8-32 Reconfigurable

Ports
4-32 Output
CC = Reconfigurable

Connector
L = LC
F = FC
C = SC
T = ST

Polish
U = UPC
P = PC
A = APC

Fibre
1 = Single mode 9/125µm
8 = Multimode 50/125µm graded index 0.20NA
9 = Multimode 62.5/125µm graded index 0.28NA

Interface
E = Ethernet & RS232
G = GPIB, Ethernet & RS232

Protocol
S = SCPI

Voltage
B = Battery (48V)
A = America (110V)
U = UK (240V)
E = Europe (220V)

Environmental
N = Normal
E = Extended

Customisation
S = Standard
V = Non-Standard Variant

FOR MORE INFORMATION

For more information on this or other products and their availability, please contact your local JDSU Uniphase account manager or JDS Uniphase directly at 1-800-498-JDSU (5378) in North America and +800 5378 JDSU worldwide or via e-mail at sales@jdsu.com.

polatis

Large Channel Count Switch Module

SKB Series

Key Features

- Lifetime greater than 120 million cycles
- Up to 100 channels
- Up to 4 switches in a module
- Internal switches can be factory configured to create various configurations, such as blocking MxN
- Latching version available
- Queriable switch position and configuration
- Status and alarm registers
- Highly customer-configurable to assist in swapping spares or changing channel order
- Operating temperature of - 35 to 75 °C for stepper-motor-based switches
- Typical IL 0.5 dB
- RL better than 55 dB
- Compact package designed to accommodate standard and custom solutions
- Printed circuit board or enclosure-mountable

Applications

- Remote fiber test systems (RFTS)
- Fiber network restoration
- Fiberoptic component test and measurement
- Integrated module solution designed for integration into new products
- OEM applications
- Sensing applications

Safety Information

- Complies with GR-1073

The JDS Uniphase SKB series controllable optical switch is designed to connect a single optical channel to any of N channels. It is the enhanced version of our legacy SK/SP series switch modules and is the only stepper-motor based switch module available in this market with a lifetime greater than 120 million cycles. Each module can accommodate multiple 1 x N switches that can be internally interconnected to provide various types of configurations, such as blocking M x N, where M represents inputs and N represents outputs, or each module can operate as independent switches.

The switch module is available in two package sizes:

- Package size 1 can accommodate up to two switches with total channel count up to 50.
- Package size 2 can accommodate up to four switches with a total channel count up to 100.

The operation of the switch is based on proven JDS Uniphase's expanded beam lens technology utilizing a precision stepper-motor to align optical channels. The use of collimating lenses minimizes insertion loss (IL). The design is optimized for high return loss (RL).

The switch is microprocessor controlled via a parallel interface or addressable serial interface (RS-485). It is designed for mounting on a printed circuit board or within a module for OEM applications.

Continued

Custom configurations and integration of passive components, with the switches in one of the two package sizes, are also available for this series of switches.

Configurations

The switch module is offered in a standard chassis with standard software that can control numerous configurations, as shown:

1 x N

A single switch with 1 x N configuration for N up to 100

MULTIPLE 1 x N

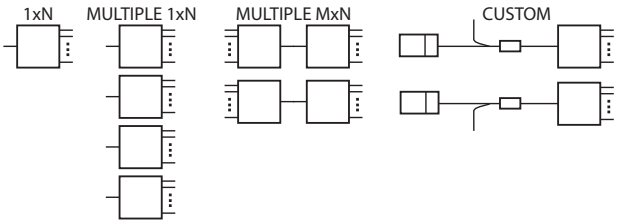
Up to four 1 x N switches with a total channel count of up to 100 (for example, four 1 x 25 optical switches or two 1 x 50 switches)

MULTIPLE M x N

Up to two M x N blocking switches for a total M + N channel count of 100

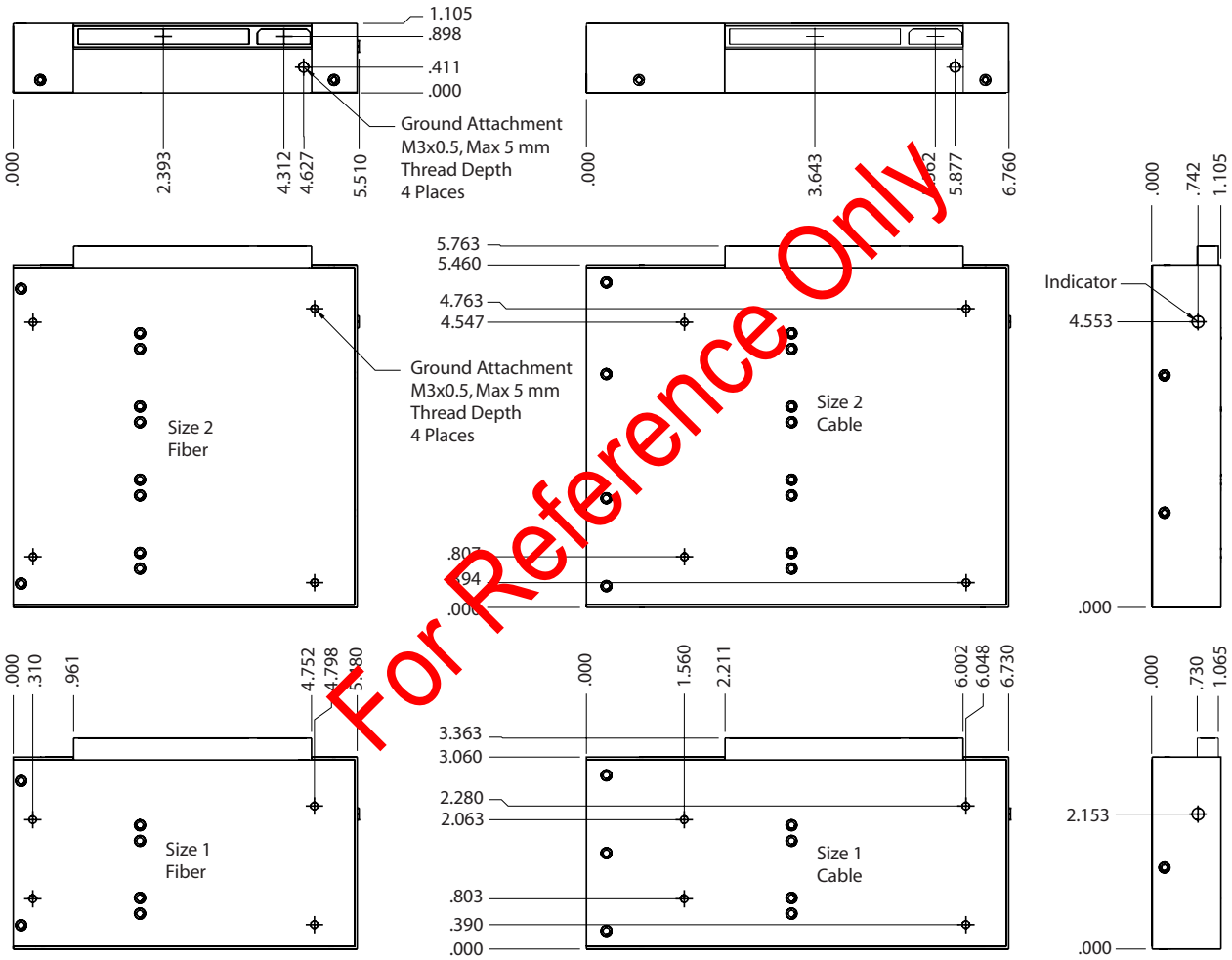
CUSTOM

1 x N switches plus passive devices, such as couplers



SKB Series Switch Configurations

Dimensions



Specifications

Parameter[1,2]	Typical (Maximum) N ≤ 25 Non-Latching N ≤ 22 Latching	Typical (Maximum) 26 ≤ N ≤ 100 Non-Latching 23 ≤ N ≤ 85 Latching
Insertion loss (IL)		
Single-mode (SM)	0.5 (0.7) dB	0.8 (1.2) dB
Multimode (MM)	0.4 (0.6) dB	0.7 (1.0) dB
Return loss(RL)[3]		
SM	62 (57) dB	55 (45) dB
MM	25 (20) dB	20 (20) dB
Polarization dependent loss (PDL) SM	0.02 (0.04) dB	0.04 (0.08) dB
IL stability[4]	± 0.02 (± 0.025) dB	± 0.03 (± 0.04) dB
Change in IL during power on-off cycle (latching version)	± 0.2 (± 0.5) dB	± 0.4 (±1.0) dB
Repeatability[4,5]		
sequential switching	± 0.005 (± 0.01) dB	± 0.01 (± 0.03) dB
random switching	± 0.01 (± 0.05 dB	± 0.03 (± 0.08) dB
Crosstalk (maximum) SM	- 80 dB	
Maximum input power (optical)	300 mW continuous	
Lifetime	> 120 million cycles	
Switching time (first channel/each additional channel)		
speed 1 (standard)	25/15 ms	
speed 2	20/15 ms	
Interface	parallel and serial interface (RS-485)	
Operating voltage	5 ± 0.25 V DC	
Power consumption	7 W maximum (package 1)/10 W maximum (package 2)	
Operating temperature	- 35 to 75 °C	
Storage temperature	- 40 to 85 °C	
Humidity	maximum 95 % RH from - 35 to 75 °C non-condensing	
Dimensions (W x H x D)		
fiber version - package 1	78.2 x 27.8 x 140.0 mm/3.08 x 1.095 x 5.51 inch	
cable version - package 1	78.2 x 27.8 x 171.7 mm/3.08 x 1.095 x 6.76 inch	
fiber version - package 2	138.4 x 27.8 x 140.0 mm/5.45 x 1.095 x 5.51 inch	
cable version - package 2	138.4 x 27.8 x 171.7 mm/5.45 x 1.095 x 6.76 inch	
Weight (configuration dependent)	0.6 kg maximum for package 1 1 kg maximum for package 2	

1. All specifications referenced without connectors.
2. All optical measurements taken after temperature has been stabilized for one hour.
3. RL specifications based on 1 m pigtail length.
4. All specifications are at speed 1 setting. Repeatability can be affected by increasing speed.
5. Measured between two consecutive readings over 100 cycles.

Ordering Information

For more information on this or other products and their availability, please contact your local JDS Uniphase account manager or JDS Uniphase directly at 1-800-498-JDSU (5378) in North America and +800-5378-JDSU worldwide or via e-mail at sales@jdsu.com.

Sample: SKB11C024L + 2B7F1FFP

SKB □ **1** □ □□□ □ **+** **2** □ □ □ □ □ □□

Code	Number of Independent Switches
1	switch
2	switches
3	switches
4	switches

Code	Optional Testing
C	standard (forward) 1xN
B	Bidirectional

Code	Features
L	Latching
N	Non-latching

Code	Number of Output Channels (per Independent Switch)
001	1 output channel
.	.
085	85 output channels (maximum for latching features)
.	.
100	100 output channels

Code	Voltage and Data Interface
A	5 V with DB9 and DB25 connector
B	5 V with disk drive connector

Code	Fiber Type (µm)
7	9/125
2	62.5/125
4	50/125

Code	Wavelength Range (nm)
F	1270 to 1670
Q	850 to 1350 (MM only)
B	750 to 940 (MM only)

Code	Pigtail Length
1	1 m
2	2 m
3	3 m

Code	Pigtail Type
F	0.9 mm tight buffer fiber
C	3.0 mm jacketed cable

Code	Connector Type
FP	FC/PC
FA	FC/APC
SC	SC/PC
SU	SC/APC
NC	No connector

Switch Output Limits

Number of Independent Switches	Maximum Outputs per Switch	
	Latching	Non-Latching
1	85	100
2	43	50
3	22	25
4	22	25

If the configurations available do not meet your performance requirements, please contact our global sales and customer service team to discuss the potential for specialized solutions.

Small Channel Count Switch Module

SW Series

Key Features

- 1 x 1, 1 x 2 and 2 by-pass modes
- Compact size
- Low IL
- High return loss (RL)
- Direct or TTL control of switching
- High repeatability over a broad range of environmental conditions
- Available in SM and MM

Applications

- Incorporation into customized switch assemblies required for test and measurement applications
- Network monitoring and testing
- Sensor switching
- Source/detection selection
- R&D

Safety Information

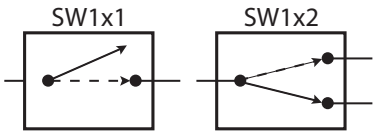
Complies to CE requirements plus UL3101-1 and CAN/CSA-C22.2 No. 1010.1

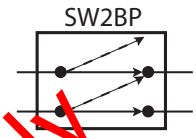
The JDS Uniphase Small Channel Count Switch Module (SW) series is used for incorporating customized test assemblies and specialized applications operating multiple source measurement instruments, such as optical spectrum analyzers, wavelength meters, and power meters. This high performance switch is suitable for system trial applications where monitoring, testing and routing are required. Other applications include sensing, calibration, reference, research and development (R&D).

In operation, the switch connects the optical channels by redirecting the optical signal into a selected output fiber. This action is achieved using optical prisms driven by a high-precision non-latching mechanism and activated by electrical control signal. Switching can be done by applying either a direct electrical or TTL control. The SW series of switch is available in both single-mode (SM) and multimode (MM).

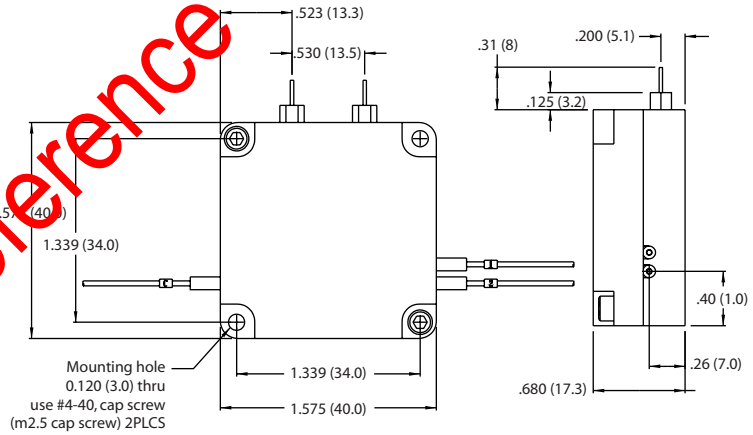
The use of collimating optics minimizes the insertion loss (IL) and improves the repeatability and stability of the optical parameters. The switch is optically passive and, therefore, is transparent to signalling formats. Configurations can be optimized for bi-directional performance as a factory option.

Dimensions

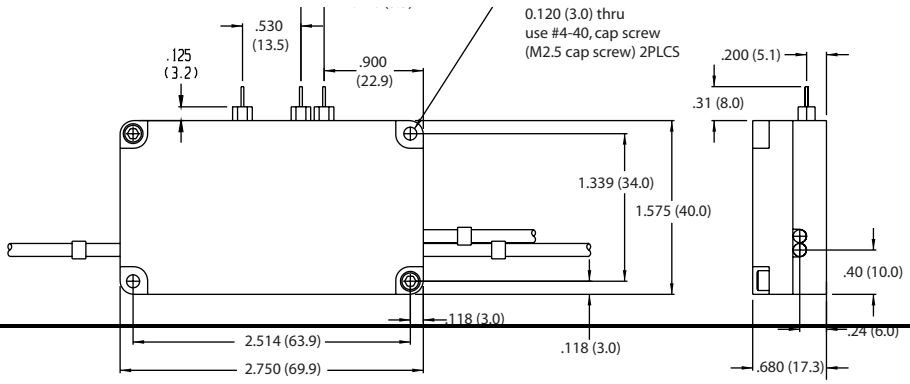




SW Series Switch Configurations



Package A



Package B

Specifications

Parameter[1]	Typical (Maximum)
Insertion loss (IL)[2, 3]	
Single-mode (SM)	0.5 (0.8) dB
Multimode (MM) SW1 x 1, 1 x 2, 2 x B	0.4 (0.7) dB
Return loss[3] (RL)	
SM (Low)	50 (45) dB
SM (Ultra-low)	60 (55) dB
MM	25 (20) dB
Polarization dependent loss (PDL)[3]	0.12 dB at 1310 nm/0.07 dB at 1550 nm maximum
IL stability[2, 3, 4, 5]	± 0.03 (± 0.05) dB
Repeatability[5, 6]	± 0.005 dB maximum
Crosstalk (maximum) SM	- 70 (- 60) dB
Optical input power SM	300 mW maximum
Lifetime	At least 10 million cycles
Switching speed	10 (15) ms
Duty cycle	5 Hz
Control interface	Direct control or transistor logic (TTL control)
Operating voltage	
Direct control	5 ± 5 % V DC at 45 mA
TTL control	5 ± 5 % V DC at 70 mA
Operating temperature	to 65 °C
Storage temperature	- 40 to 80 °C
Humidity	95 % maximum, non-condensing
Dimensions (W x H x D)	40 x 17 x 40 mm (fiber) or 70 x 17 x 40 mm (cable) - package A or B
Weight	45 and 80 g (packages A and B respectively)

1. Customized specifications are available.
2. At room temperature and optimized at 850, 1310 or 1550 nm.
3. Excluding connectors.
4. Drift of any channel relative to the straight-through path at ± 3 °C deviation of ambient temperature over a seven-day period.
5. Please contact JDS Uniphase for details on testing methods.
6. Measured between two consecutive readings over 100 cycles.

Ordering Information

For more information on this or other products and their availability, please contact your local JDS Uniphase account manager or JDS Uniphase directly at 1-800-498-JDSU (5378) in North America and +800-5378-JDSU worldwide or via e-mail at sales@jdsu.com.

Sample: SW101+2075UFPE1.5

SW □ □□ **+ 2** □ □ □ □ □□ □ □.□

Code	Number of Input Channels
1	1
2	2

Code	Number of Output Channels
01	1
02	2
BP	Bypass

Code	Control Type
0	Direct
2	TTL

Code	Fiber Type (µm)
7	9/125
1	50/125
2	62.5/125
4	100/140

Code	Wavelength Range (nm)
D	1310/1550
3	1310
5	1550
8	850 (MM only)
Q	850/1310 (MM only)

Code	Connector Type
FP	FC/PC
FA	FC/APC
SC	SC/PC
SU	SC/APC
N	No connector

Code	Return Loss
S	45 dB (SM only)
U	55 dB (SM only, high RL)
M	20 dB (MM only)
B	Bidirectional 55 dB (SM) 20 dB (MM)

Code	Pigtail Type
L	3.0 mm jacketed cable
E	900 µm tight buffer fiber

Code	Pigtail Length
0.3	minimum length
…	…
1.5	1.5 meters (standard pigtail length)
…	…
9.9	9.9 meters

Mechanical Package (based on switch type):

Switch Type	900 µm fiber	3 mm cable
1 x 1	A	B
1 x 2	A	B
2BP	A	B

Where A = 40 x 17 x 40 mm (W x H x D)

and B = 70 x 17 x 40 mm (W x H x D)

If the configurations available do not meet your performance requirements, please contact our global sales and customer service team to discuss the potential for specialized solutions.

Ruggedized Small Channel Count Switch Module

SR Series

Key Features

- Typical IL 0.6 dB
- Return loss (RL) greater than 55 dB
- Several configurations available
- Reliable, small modules suitable for rugged environments where vibration and shock performance are critical
- Simple control

Applications

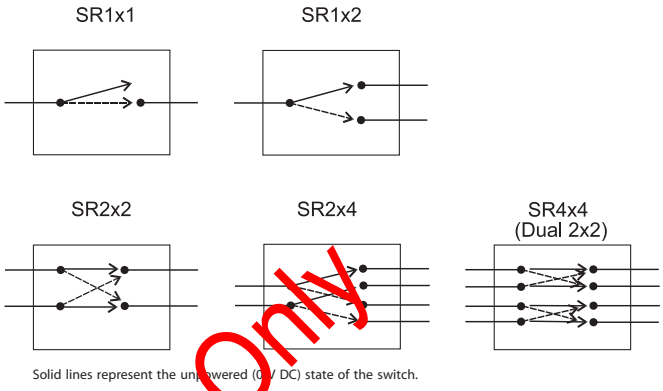
- Optical signal routing, fiber network configuration, and restoration
- Sensor switching, source/detection selection, reference, and multisource measurements in instrumentation products
- Fiberoptic component testing
- Research and development (R&D)

The SR series switches are manufactured for harsher environments, and are specified for a wide operating temperature range of -25 °C to +65 °C.

Both single-mode (SM) and multimode (MM) versions of the SR Series switch connect optical channels by redirecting optical signals into a selected output fiber. This is achieved using a mirror driven by a highly precise mechanism that is activated via an electrical control signal.

Using collimating lenses minimizes the insertion loss (IL) and improves the repeatability and stability of the switch parameters. The SR Series is optically passive and is, therefore, transparent to signalling formats and bandwidth. All configurations are optimized for bidirectional performance.

Continued



Solid lines represent the unpowered (0 V DC) state of the switch.

SR Series Switch Configurations

Specifications

Parameter	Typical	Maximum
Insertion loss (IL)		
Single-mode[1] (SM) 1 x 1, 1 x 2, 2 x 4	0.6 dB	0.9 dB
SM 2 x 2 and 4 x 4	0.9 dB	1.2 dB
Multimode[1] (MM) 1 x 1, 1 x 2, 2 x 4	0.5 dB	0.8 dB
MM 2 x 2 and 4 x 4	0.8 dB	1.1 dB
Return loss (RL)		
SM[2]	50 dB	45 dB
SM[2] (high RL)	60 dB	55 dB
MM	25 dB	20 dB
Polarization dependent loss (PDL)[2]		
SM	0.06 dB	0.1 dB
IL stability[3]	± 0.03 dB	± 0.05 dB
Repeatability[4]	± 0.01 dB	± 0.02 dB
Crosstalk		
SM	- 60 dB	- 50 dB
MM	- 45 dB	- 35 dB
Optical input power	N/A	300 mW
Switching time	7 ms	10 ms
Control signal duration	25 ms	N/A
Cycle rate	N/A	10 Hz
Power	5 ± 5 % V DC/50 mA (75 mA for TTL option)	
Control	Direct or TTL	
Operating temperature	N/A	- 25 to 65 °C
Storage temperature	N/A	- 40 to 80 °C
Humidity (non-condensing)	N/A	95 %
Dimensions (W x H x D)	SR1 x 1, 1 x 2, 2 x 2 70 x 17 x 40 mm (fiber or cable version)	
SR2 x 4, Dual 2 x 2	70 x 17 x 44 mm (fiber version)	
SR2 x 4, Dual 2 x 2	101 x 17 x 44 mm (cable version)	
Weight	90 g (110 g for SR2 x 4, Dual 2 x 2)	

1. Excluding connectors. Include 0.2 dB (typical IL) for each connector.
2. Excluding connectors.
3. Drift of any channel relative to one assigned reference channel at ± 3 °C deviation of ambient temperature over seven day period.
4. Measured between two consecutive readings over 100 cycles.

Ordering Information

For more information on this or other products and their availability, please contact your local JDS Uniphase account manager or JDS Uniphase directly at 1-800-498-JDSU (5378) in North America and +800-5378-JDSU worldwide or via e-mail at sales@jdsu.com.

Sample: SR44+2228MNCE

SR □ □ +2 □ □ □ □ □□ □ □.□

Code	Number of Input Channels
1	1
2	2
4	4

Code	Number of Output Channels
1	1
2	2
4	4

Code	Control Type
0	Direct
2	TTL

Code	Fiber Type (µm)
1	50/125
2	62.5/125
4	100/140
7	9/125

Code	Wavelength Range (nm)
D	1310/1550
3	1310
5	1550
8	850 (MM only)

Code	Return Loss
L	45 dB (SM only)
U	55 dB (SM only, high RL)
M	20 dB (MM only)

Code	Connector Type
FP	FC/PC
FA	FC/APC (SM only)
SC	SC/PC
SU	SC/APC (SM only)
NC	N connector

Code	Pigtail Type
L	3.0 mm jacketed cable
E	900 µm tight buffer fiber

Code	Pigtail Length
0.3	minimum length
…	…
1.5	1.5 meters (standard pigtail length)
…	…
9.9	9.9 meters

Flexible Small Channel Count Switch Module

SQ Series

Key Features

- High optical performance
- High repeatability
- Latching or non-latching
- Field configurable default non-latch channel
- Wide choice of configurations
- Off position (optional)
- Status feedback
- Common package size for all configurations

Applications

- Incorporation into customized switch assemblies for test and measurement applications
- Network monitoring and testing
- Sensor switching
- Source/detection selection
- Research and development (R&D)

Safety Information

- Complies with GR-1073

The JDS Uniphase SQ series optical switch is a highly flexible module with high optical performance in latching or non-latching applications. The full feature set and large number of optical configurations available in a common package and interface make it ideal for a wide spectrum of applications.

The switch connects one or two channels to one of several (up to eight) channels. Both single-mode (SM) and multimode (MM) versions are available. This switch is also available in multi-pack configurations, for example 2 x 4, 2 x 6, 2 x 8 D configuration (Duplex 1 x 2, 1 x 3, 1 x 4).

While in operation, the switch connects optical channels by using prisms to redirect the signal from an input port into a selected output port. Using collimating optics minimizes the insertion loss (IL) and improves the repeatability and stability of the optical parameters. The switches are optically passive, and therefore, are transparent to signaling formats.

Configurations can be manufactured for bi-directional performance as a factory option.

SQ Series Configurations

The common package may be ordered in optical configurations as follows:

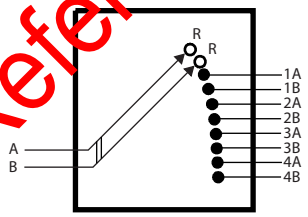
- 1 x 3 up to 1 x 8
- 2 x 4, 2 x 6, 2 x 8 D configuration (Duplex 1 x 2, 1 x 3, 1 x 4)
- Dual 1 x 2
- SM or MM fiber
- 900 mm buffered fiber or 3 mm cable

All units are customer-configurable as:

- Latching
- Non-latching
- Default channel for non-latch operation

Electrical interfaces available include:

- 2 x 12 male header on the side
- 2 x 12 male (recessed) on the bottom (for PCB mounting)

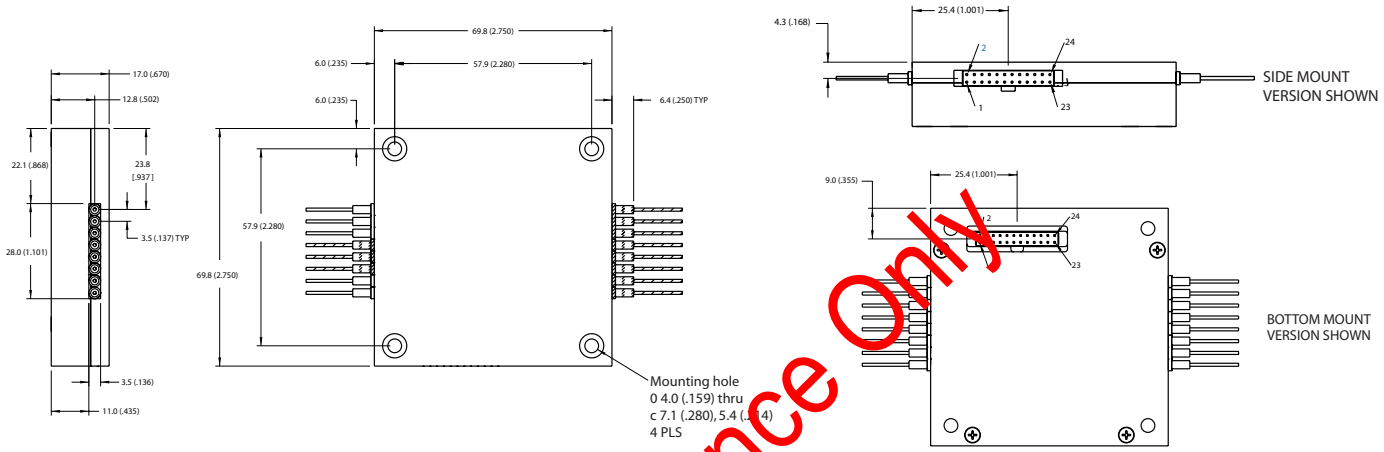


D Configuration

(SQ switch shown with OFF position option)

The 2 x N configuration allows for mass reconfiguration of optical paths. It provides simultaneous connections of 2 inputs to a number of outputs.

Dimensions



Specifications

Parameter	Specification
Wavelength range	
Single-mode (SM) or Multimode (MM)	1270 to 1670 nm
MM only	850 to 1350 nm
Fiber type	
SM	9/125 µm
MM	50/125 µm, 62.5/125 µm
Fiber jacket size	900 µm fiber, 3.0 mm cable
Configuration	1 x 3 to 1 x 8 Dual 1 x 2 (2 independent 1 x 2's) Duplex 1 x 2 (2 x 4 "D") Duplex 1 x 3 (2 x 6 "D") Duplex 1 x 4 (2 x 8 "D")
Optical connectors	FC/PC, FC/APC, SC/PC, SC/APC, LC/PC, no connector
Length	0.3 to 9.9 m (± 5 cm for lengths under 1 m, ± 5% for lengths 1 m or greater)
Test orientation	Standard Bi-directional

Specifications

Parameter[1]	Single-mode (SM)	Multimode (MM)
Insertion loss (IL)[2] (includes one FC/PC connection)		
1 x 3, 1 x 4, Dual 1 x 2, 2 x 4 "D"	< 1.1 dB	< 1.0 dB
1 x 5, 1 x 6, 1 x 7, 1 x 8, 2 x 6 "D", 2 x 8 "D"	< 1.25 dB	< 1.15 dB
Return loss (RL) (excludes connectors)		
selected port SM	> 55 dB	
selected port MM	> 30 dB	
Polarization dependent loss (PDL)(SM only)		
1 x 3, 1 x 4, Dual 1 x 2, 2 x 4 "D"	< 0.08 dB	
1 x 5, 1 x 6, 1 x 7, 1 x 8, 2 x 6 "D", 2 x 8 "D"	< 0.10 dB	
IL stability[3]		
1 hour	± 0.02 dB	
24 hours	± 0.05 dB	
Repeatability[4,5]		
1 x 3, 1 x 4, Dual 1 x 2, 2 x 4 "D"	< 0.01 dB (p-p)	(± 0.005 dB)
1 x 5, 1 x 6, 1 x 7, 1 x 8, 2 x 6 "D", 2 x 8 "D"	< 0.02 dB (p-p)	(± 0.01 dB)
Crosstalk/isolation		
selected port to other ports	< - 60 dB	< - 50 dB
bi-directional - non-selected to other non-selected	< - 50 dB	< - 40 dB
Optical input power	300 mW max	
Lifetime	> 10 million cycles	
Switching time	< 20 ms	
Control interface	Configurable TTL	
Operating voltage (DC)[2,6]	5.0 V DC ± 10 % at 100 mA (300 mA max during switching)	
Qualification testing	GR1073 for Central Office 182 g (1 x 8, 1.5 meters of 900 µm fiber, FC/PC connectors)	
Operating temperature	0 to 60 °C	
Storage temperature	- 40 to 85 °C	
Humidity (relative, non-condensing)		
Operating	< 90 % at 23 °C < 20 % at 60 °C	
Storage	< 90 % at 60 °C < 40 % at 85 °C	
Dimensions (W x H x D)	70 x 17 x 70 mm	
Weight	119 g (1 x 8, 1.5 meters of 900 µm fiber, no connectors)	

1 Unless otherwise specified, all specifications at start of life at 23 °C ± 3 °C and 45 % RH ± 5 %.

2 At 23 °C ± 3 °C at specified test wavelengths (850/1310 MM or 1310/1550 SM) and optical input power of - 25 to 0 dBm.

3 Drift of any channel at ± 3 °C deviation of ambient temperature without changing channels (excludes repeatability).

4 Repeatability as per Telcordia GR-1073-CORE (100 cycles, max-min/peak-to-peak).

5. Measured between two consecutive readings over 100 cycles.

6. At 23°C. Over full temperature range: 5.0 V ± 5%.

Ordering Information

For more information on this or other products and their availability, please contact your local JDS Uniphase account manager or JDS Uniphase directly at 1-800-498-JDSU (5378) in North America and +800-5378-JDSU worldwide or via e-mail at sales@jdsu.com.

Sample: SQ141N+137FFPL1.0

SQ □□ □ □ +1 □ □ □ □□ □ □.□

Code	Optical Configurations
13	1 x 3
14	1 x 4
15	1 x 5
16	1 x 6
17	1 x 7
18	1 x 8
D4	Duplex 1 x 2 (2 x 4 D config.)
D6	Duplex 1 x 3 (2 x 6 D config.)
D8	Duplex 1 x 4 (2 x 8 D config.)
22	Dual 1 x 2 (2 of 1 x 2)

Code	Test Configuration
1	Forward
3	Bidirectional

Code	Option
Y	Off position
N	Standard channel config.

Code	Control Interface
3	2 x 12 side header
4	2 x 12 bottom header

Code	Fiber Type (µm)
7	9/125
5	50/125
2	62.5/125

Code	Wavelength (nm)
F	1270 to 1670
Q	850 to 1350 (MM only)

Code	Connector Type
FP	FC/PC
FA	FC/APC
SC	SC/PC
SU	SC/APC
NC	No connector

Code	Pigtail Type
L	3.0 mm jacketed cable
E	900 µm tight buffer fiber

Code	Pigtail Length
0.3	minimum length
…	…
1.5	1.5 meters (std)
…	…
9.9	9.9 meters

If the configurations available do not meet your performance requirements, please contact our global sales and customer service team to discuss the potential for specialized solutions.

Custom Switch Assembly

SA Series

Key Features

- Flexible arrangement
- GPIB and RS-232 remote control
- Local control via keypad and display

Applications

- Fiber test systems in telecommunications, data communications, CATV
- Fiberoptic component testing
- Transmitter/receiver measurements
- Research and development (R&D)

Safety Information

Complies to CE requirements plus UL3101-1 and CAN/CSA-C22.2 No. 1010.1

Specifications

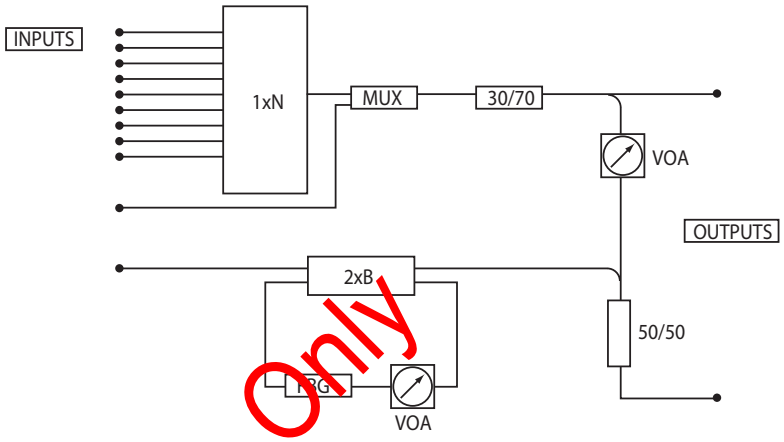
JDS Uniphase customizes each switch assembly to meet your specifications.

JDS Uniphase can meet your specific test application needs with the flexible Custom Switch Assembly Platform. We combine 1 x N programmable switches, modular relay-based 1 x 2, 2 x 2, 1 x 3, and other switches, splitters, couplers, attenuators, laser sources, isolators, and circulators in one package with custom front and rear panels. For example, we can combine custom-labeled inputs and outputs with the optical schematic corresponding to input/output labels. The compact switch assembly's optical units are controlled by the front panel keys and GPIB or RS-232 interfaces. LabVIEW drivers are available.

The Switch Assembly can be packaged in either a 3U or a 6U high rackmount unit, depending on the number of optical elements required.

Custom Switch Assemblies are also available in our Multiple Application Platform (MAP) platform as MAP-SA modules. The MAP-SA solution provides the capability of integrating various MAP-compatible switches (like the SW and SKB) along with attenuators, tunable filters, passive components such as tap couplers, and all other MAP-based cassettes. The MAP-SA modules can be made in any size, from single-width to a full 8-wide cassette, allowing all components to be pre-configured at the factory for easy installation at the customer site.

Continued



Sample Custom Switch Configuration

Benchtop Instruments

Amplifiers - Erbium-doped fiber amplifiers (EDFAs) have been developed as a key technology for increasing the bandwidth of optical systems. EDFAs provide a convenient way to overcome component loss, especially in multichannel dense wavelength division multiplexing (DWDM) long haul systems.

Attenuators - In 1983, JDS Uniphase invented the Manually Variable Attenuator in response to the need for highly accurate calibration. JDS Uniphase attenuators have continued to evolve with our industry-leading HA Series and now our modular MAP-based programmable versions.

Emulators - Polarization Mode Dispersion (PMD) Emulators produce accurately controlled amounts of PMD for fiberoptic systems testing, such as assessing PMD effects on systems and calibrating PMD-measuring equipment. Optical Delays accurately control the length of the path that the input signal travels and thereby the delay time of transmitted light in an optical fiber. They can also be used to vary the modulation phase of reflections for the testing of reflection effects on transmitters.

Electro-optic Instruments - The Stressed Eye Generator provides a low cost feature rich source supporting both Receiver Conformance Testing (RCT) and Transmitter and Dispersion Penalty Testing (DPT). When combined with an electrical PG with the special jitter input, a fully compliant 802.3ae Stressed Eye is achieved.

Sources - Optical broadband sources have the advantage of offering a wide measurement range as well as a constant power and spectrum output. The Benchtop Broadband Source features excellent output stability for both power and spectrum, making it an ideal source for passive component testing.

Included in This Section

In addition to the modular MAP products, JDS Uniphase also offers individually-packaged benchtop instruments. These are stand-alone products with features and specifications that complement those available in MAP instrument cassettes.

The following table lists the instruments available in the various classes, along with some pertinent features. Detailed specifications and ordering information can be found on the product pages.

INSTRUMENT	SPECIAL FEATURES
Erbium-Doped Fiber Amplifier	High output power and additional wavelength ranges
Programmable Attenuator	Special wavelength ranges, higher attenuation available
Manual Variable Attenuator	Compact instrument for field testing or lab applications
Stressed Eye Generator	Stressed-eye conformance test solution
PMD Emulator	Highly accurate PMD emulation
Optical Delay	Highly accurate optical delay production
Broadband Source	Additional wavelength ranges and higher output power levels supported

Benchtop Erbium-Doped Fiber Amplifier

EDFA Series

Key Features

- Choice of wavelengths C- or L- bands
- High output power and gain
- Mid-span access
- Compact benchtop design with rackmount kit
- Single channel and multichannel dense wavelength division multiplexing (DWDM) capabilities
- RS-232 remote control

Applications

- Pre-amp booster, in-line amplifier emulation
- Dense wavelength division multiplexing (DWDM) transmission, for multichannel applications
- SONET/SDH systems, for single channel applications

Safety Information

Complies to CE requirements plus UL3101-1 and CAN/CSA-C22.2 No. 1010.1
Meets the requirements of Class 3B in standard IEC 60825-1(2002) and complies with 21CFR1040.10 except deviations per Laser Notice No. 50, July 2001.

INVISIBLE LASER RADIATION
AVOID EXPOSURE TO BEAM
CLASS 3B LASER PRODUCT
(IEC 60825-1, 2002)
MAX. 500 mw, 700-1680 nm

The Benchtop Erbium-Doped Fiber Amplifier (EDFA) amplifies optical signals across the EDFA window (1528 to 1610 nm). Through optimization of amplifier gain, noise figure, and saturated output power, the EDFA will expand your test capabilities in systems, components or sub-assembly manufacturing as well as research and development (R&D) environments.

The amplifier incorporates a unique design to produce maximum signal gain and saturated output power in the 1550 and 1590 nm test bands while minimizing noise figure. It features a user-friendly front panel housing an LCD displaying input/output power, current control and an optical interface.

The amplifier is offered in C-band, L-band and C+L-band versions and pre-amplifier, booster, or in-line amplifier configurations.

The Benchtop models provide specialized variants and optical performance not available in the Multiple Application Platform (MAP) line. Additional EDFA models are available in the MAP EDFA product line.

Specifications

MODEL	OAB1552	OAB1592	OAB1596	OAB1598	OAB1562	OAB1564
Test band	C-band	L-band	L-band	L-band	C+L-band	C+L-band
Amplifier type	Booster high power	Booster high power	Mid-span access DWDM	Booster DWDM	Booster	In-line
Operating wavelength range	1528 to 1565 nm	1565 to 1610 nm	1570 to 1603 nm	1570 to 1603 nm	1530 to1560 nm 1570 to1600 nm	
Input signal	Single channel		Multichannel DWDM		Single Channel	
Saturated output power[1]	≥ 24 dBm	≥ 22 dBm	≥ 20 dBm	≥ 20 dBm	≥ 19 dBm	≥ 14 dBm
Noise figure[2]	≤ 5.0 dB	≤ 5.5 dB	≤ 5.8 dB	≤ 5.5 dB	≤ 6.5 dB	≤ 6.5 dB
Small signal gain[3]	≥ 36 dB	≥ 29 dB	≥ 22 dB (MS loss ≤ 7 dB)	≥ 20 dB	≥ 22 dB	≥ 20 dB
Spectral gain flatness[4]	N/A					
Polarization dependent loss (PDL)	≤ 0.2 dB	≤ 0.3 dB	≤ 0.3 dB	≤ 0.9 dB	≤ 0.4 dB	≤ 0.4 dB
Polarization mode dispersion (PMD)	≤ 0.4 ps	≤ 0.8 ps	≤ 0.8 ps	≤ 0.9 ps	≤ 0.7 ps	≤ 0.7 ps
Input/output isolation	≥ 45/32 dB	≥ 40/40 dB	≥ 40/40 dB	≥ 40/40 dB	≥ 40/40 dB	≥ 40/40 dB
Input/output monitors	Yes					
Input voltage	100 to 240 V AC, 50 to 60 Hz					
Power consumption	300 V A Maximum					
Packaging	Half-rack benchtop and 19-inch rackmount kit					
Operating temperature	0 to 50 °C					
Storage temperature	- 40 to 70 °C					
Humidity	Maximum 95 % RH non-condensing from 0 to 45 °C					
Dimensions (W x H x D)	21.2 x 8.9 x 35.5 cm					
Weight	> 4 kg					

1. Saturated Output Power measured:
   At 1550 nm at P_{in} = - 4 dBm for model 1552
   At 1590 nm at P_{in} = 0 dBm for model 1592 and 1598
   At 1590 nm at P_{in} = - 2 dBm for model 1596
   At 1550 nm at P_{in} = - 4 dBm and at 1590 nm and P_{in} = 0 dBm for model 1562 and 1564

2. Noise figure measured:
   At P_{in} = - 4 dBm for model 1552 and 1592
   At P_{in} = - 2 dBm for model 1596
   At P_{in} = 0 dBm for model 1598
   At P_{in} = - 20 dBm for model 1562 and 1564

3. Small signal gain measured:
   At P_{in} = -20 dBm for model 1552, 1562, 1564, and 1592
   At P_{in} = -2 dBm for model 1596
   At P_{in} = 0 dBm for model 1598

4. Flatness optimized for:
   P_{in} = - 2 dBM for model 1596
   P_{in} = 0 dBm for model 1598

Ordering Information

For more information on this or other products and their availability, please contact your local JDS Uniphase account manager or JDS Uniphase directly at 1-800-498-JDSU (5378) in North America and +800-5378-JDSU worldwide or via e-mail at sales@jdsu.com.

Sample: OAB1554+20FP0

OAB □□□□ **+** **2** □ □□ □

Code	Description
1552	C-band Booster high power
1592	L-band Booster high power
1596	L-band Mid-span access DWDM
1598	L-band Booster DWDM
1562	C+L-band Booster
1564	C+L-band In-Line

Code	Connector Type
FP	FC/PC
FA	FC/APC
SC	SC/PC
SU	SC/APC

Code	Output Power
0	Standard output power
4	Booster high output power, 22 dBm (available for OAB1502)
6	Booster high output power, 24 dBm (available for OAB1552)

Code	Characteristics
0	unflattened
2	Gain flattened DWDM (available for OAB1546, OAB1558, OAB1596, OAB1598)

Standard Accessories

Part Number	Description
ED000899-A-00	Standard 19-inch rackmount kit

Optional Accessories

Part Number	Description
ED000899-A-01	Rackmount kit (Japan)

Programmable Attenuator

Key Features

- 100 dB range
- 0.01 or 0.001 dB resolution
- 0.01 dB repeatability
- Accuracy of ± 0.1 dB
- Typical polarization dependent loss (PDL) of 0.03 dB
- 1200 to 1700 nm or 750 to 1700 nm wavelength ranges
- Built-in beam block
- GPIB and RS-232 remote control
- Single-mode (SM) or multimode (MM) fiber
- SCPI compatible command set
- Optional couplers or switches
- High power input of 1000 mW
- Wavelength dependence of less than ± 0.05 dB over 1530 to 1625 nm range

Applications

- Precise optical power control
- Power meter linearity calibration
- Analog transmission tests
- Bit error rate (BER) tests
- Loss simulation in fiberoptic links
- Erbium-Doped Fiber Amplifier (EDFA) output power characterization

Safety Information

Complies to CE requirements plus UL3101-1 and CAN/CSA-C22.2 No. 1010.1

The JDS Uniphase Programmable Attenuator is a high-resolution, extended-range, programmable attenuator ideal for testing power meters and general test and laboratory work. The attenuator has a nominal resolution of 0.01 dB (0.001 dB for the HA1 series) and an extended attenuation range up to 100 dB. The standard operating wavelength is 1200 to 1700 nm (750 to 1700 nm is available for use with a reduced attenuation range of 60 dB for the HA9W attenuator).

HA attenuators are ideal for use in such demanding applications as multichannel AM systems and high bit-rate digital pulse code modulation (PCM) systems. Discrete internal optical reflections are minimized to better than 60 dB, and cavity effects are virtually eliminated. All HA attenuators are offered with high return loss (RL) and low spectral ripple for CATV AM systems.

The HA2 series Programmable Attenuator provides a **low** wavelength dependence of ± 0.05 dB and input power up to 1 W (30 dBm). The HA2 is suitable for a variety of applications including amplifier testing and dense wavelength division multiplexing (DWDM) system characterization.

The inherently linear design of these attenuators, combined with built-in calibration and offset functions, allows the user to match the display to an optical power meter over a wide power range. This feature is useful in tests requiring control of the absolute optical power source for the test device. The built-in beam blocking switch provides fast access from any attenuation setting to infinite attenuation (> 90 dB).

Continued

Front panel access provides the option of increasing functionality through the addition of other devices, such as couplers or switches. The 5 V driver key on the front panel (connected to the 5 V driver on the back) acts as a toggle for an external or internal (if installed) switch.

The HA9 and HA1 attenuators can be fitted with a 10/90 or 50/50 coupler or a 1 x 2 switch to provide an output tap to access two inputs or outputs. All models have an SCPI/HP8156A compatible command set and can be controlled from the front panel keyboard or by the GPIB or RS-232 interfaces.

Specifications

Parameter	HA1 High Resolution	HA 9 Highly Configurable	HA9W Wide Wavelength Range	HA9P Flexcor Fiber	HA2 High Power and Wavelength Flat
Operating wavelength range	1200 to1700 nm	1200 to 1700 nm	750 to 1700 nm	980 to 1100 nm	1280 to 1670 nm
Attenuation[1]					
Range	100 dB	100 dB	60 dB	60 dB	50 dB
Resolution	0.001 dB	0.01 dB	0.01 dB	0.01 dB	0.01 dB
Repeatability[2]	± 0.01 dB	± 0.01 dB	± 0.01 dB	± 0.01 dB	± 0.01 dB
Change rate	≤ 2.5 s 0 to 100 dB	≤ 2.5 s 0 to 100 dB	≤ 1.5 s 0 to 60 dB	≤ 1.5 s 0 to 60 dB	≤ 1.5 s 0 to 50 dB
Accuracy[3]	± 0.1 dB	± 0.1 dB	± 0.1 dB	± 0.1 dB	± 0.1 dB
Insertion loss (IL)[4, 5, 6]					
Single-mode (SM)	≤ 1.5 dB	≤ 1.5 dB	≤ 5.0 dB	N/A	≤ 1.0 dB[8]
Multimode (MM), 50/125µm	N/A	≤ 2.2 dB	≤ 3.2 dB	N/A	N/A
MM, other	N/A	≤ 2.9 dB	≤ 3.9 dB	N/A	N/A
Flexcor 1060	N/A	N/A	N/A	≤ 2.5 dB	N/A
Return loss (RL)[4, 5]					
SM	N/A	≥ 45 dB	≥ 45 dB	N/A	N/A
SM, analog[7]	≥ 60 dB	≥ 60 dB	≥ 60 dB	N/A	≥ 50 dB
MM, 50/125 µm	N/A	≥ 35 dB	≥ 35 dB	N/A	N/A
MM, other	N/A	≥ 30 dB	≥ 30 dB	N/A	N/A
Flexcor 1060	N/A	N/A	N/A	≥ 60 dB	N/A
Wavelength dependence[4, 9]	N/A	N/A	N/A	N/A	± 0.05 dB (0 to 20 dB attenuation)
(1530 to 1625 nm)	N/A	N/A	N/A	N/A	± 0.10 dB (20 to 30 dB attenuation)
Maximum optical input power	200 mW	200 mW	200 mW	200 mW	1 W
Recalibration period (recommended)	2 years				
Polarization dependent loss (PDL)[4, 5]	0.03 dB typical, 0.08 dB maximum				
Beam block attenuation	≥ 90 dB				
Input voltage	100 to 240 V AC, 50 to 60 Hz				
Power consumption	100 V A maximum				
Operating temperature	0 to 40 °C				
Storage temperature	- 40 to 60 °C				
Humidity	maximum 90 % up to 40 °C				
Dimensions (W x H x D)	21.2 x 8.9 x 35.5 cm 19-inch (48.26 cm) rackmounting 2U high				
Weight	4 kg				

1. The attenuation range is a continuous function of wavelength.
2. At constant temperature, wavelength, and polarization state after half-hour warm-up.
3. Up to 60 dB of attenuation for SM and 45 dB of attenuation for MM. Maximum specification at calibrated wavelength ± 15 nm. Outside these wavelength ranges, the typical accuracy is the greater of ± 0.1 dB or ± 0.003 dB/dB.
4. Measured at 23 °C with a laser source.
5. Not including connectors, switch, or coupler (if installed).
6. Over 850 to 1600 nm. IL is typically highest at wavelength extremes.
7. Total of discrete reflections. Does not include distributed reflection in fiber.
8. From 1375 to 1670 nm, < 1.5 dB from 1280 to 1375 nm.
9. Relative to reference 0 dB setting.

Ordering Information

For more information on this or other products and their availability, please contact your local JDS Uniphase account manager or JDS Uniphase directly at 1-800-498-JDSU (5378) in North America and +800-5378-JDSU worldwide or via e-mail at sales@jdsu.com.

Sample: HA097+28KFA1

HA □□ □ +2 □ □ □□ □

Code	Model
01	HA1 (high resolution, 1200 to1700 nm)
02	HA2 (high power, wavelength flat)
09	HA9 (1200 to 1700 nm)
9P	HA9P (Flexcor 1060, 980 to1100 nm)
9W	HA9W (750 to 1700 nm)

Code	Fiber Type (µm)
1	50/125 (HA9 and HA9W only)
2	62.5/125 (HA9 and HA9W only)
7	9/125
8	Flexcor 1060 (HA9P only)

Code	Built-in Options
0	None
1	50/50 coupler (9/125 µm only)
8	1:2 switch (HA1 and HA9 only)
9	10/90 coupler (9/125 µm only)

Code	Return Loss
K	Standard
A	Analog

Code	ConnectorType (all ports)
FP	FC/PC
FA	FC/APC
SC	SC/PC
SU	SC/APC

Code	Port Type
1	Bulkheads on front
3	Pigtails on front

If the configurations available do not meet your performance requirements, please contact our global sales and customer service team to discuss the potential for specialized solutions.

Manual Variable Attenuator

Key Features

- Precision attenuation
- Two calibration wavelengths
- Low IL
- RL > 60 dB
- Very long battery life
- Portable for field use
- Rear bulkhead connectors

Applications

- Optical power control
- Receiver testing
- Field system testing
- Power meter linearity checks

The JDS Uniphase Manual Variable Attenuator is a compact, portable instrument for field system testing and test and development in laboratory applications. It provides continuously variable attenuation range of up to 65 dB with calibration wavelengths of 830/1300 nm or 1300/1550 nm. Attenuation is set manually from the front panel at a 0.1 dB resolution. Unlike programmable attenuators, the attenuation level is maintained when the power is turned on or off. The attenuators use JDS Uniphase's ultra-linear attenuator prism to produce accurate attenuation settings with low insertion loss (IL) and excellent return loss (RL).

The display features a large-scale LCD readout, and the instrument is powered by a long-lasting 9 V lithium battery for hand-held operation in the field. Input and output ports are equipped with rear panel-mounted connector bulkheads, and all major connector types are available.

Specifications

Parameter	1300/1550 nm	830/1300 nm
Attenuation range	65/60 dB	50/40 dB
Maximum insertion loss (IL)[1, 2]		
Single-mode (SM)	≤ 3.0 dB	≤ 7.0 dB
Multimode (MM), 50/125 µm	≤ 3.2 dB	≤ 4.2 dB
MM, other	≤ 3.9 dB	≤ 4.9 dB
Return loss (RL)[3]		
SM, analog	> 60 dB	
MM, 50/125 µm	> 35 dB	
MM, 62.5/125µm	> 20 dB	
Maximum optical input power	300 mW	
Attenuation accuracy[2]	± 0.5 dB	
Display resolution	0.1 dB	
Repeatability[2]	± 0.1 dB	
Polarization dependent loss (PDL)[2]	≤ 0.1 dB	
Recalibration period (recommended)	2 years	
Battery lifetime[4, 5, 6]	> 6000 hours	
Operating temperature	0 to 50 °C	
Storage temperature	- 40 to 60 °C	
Humidity	maximum 95 % RH from 0 to 50 °C	
Dimensions (W x H x D)	11.5 x 6 x 12.5 cm	
Weight	0.82 kg	

1. Including 0.2 dB for each connector.
2. Measured at 25 °C using unpolarized light at either calibration wavelength.
3. Excluding connectors.
4. With continuous display use.
5. A "Low Battery" message is displayed when battery replacement is required.
6. 9 V lithium battery.

Ordering Information

For more information on this or other products and their availability, please contact your local JDS Uniphase account manager or JDS Uniphase directly at 1-800-498-JDSU (5378) in North America and +800-5378-JDSU worldwide or via e-mail at sales@jdsu.com.

Sample: VA47K+1ASU20

VA 4 □ □ + 1 □ □ □ 2 0

Code	Fiber Type (µm)
1	50/125
2	62.5/125
4	100/140
7	9/125

Code	Calibrated Wavelengths (nm)
G	830/1300
K	1300/1550

Code	Return Loss
K	Multimode (MM) fiber
A	Single-mode (SM) fiber

Code	Connector Type
FP	FC/PC
FA	FC/APC
SC	SC/PC
SU	SC/APC

Stressed Eye Generator

Key Features

- 850 nm, 1310 nm and 1550 nm wavelength options
- Operational from 155 Mb/s to 10.71 Gb/s data rates
- Adjustable extinction ratio
- Four selectable data paths (reference, OMA, internal BT filter or external filter)
- Accepts sinusoidal amplitude interference inputs
- Front panel LCD or GPIB control

Applications

- Manufacturing and R&D receiver testing including 10 Gb/s Ethernet and Fibre Channel
- Manufacturing and R&D Datacom/Telecom reference transmitter
- Dispersion penalty testing
- System testing

Safety Information

Complies to CE requirements plus UL3101-1 and CAN/CSA-C22.2 No. 1010.1 Meets the requirements of Class 1 (1310,1550 nm) and Class 3R (850 nm) in standard IEC 60825-1(2002) and complies with 21CFR1040.10 except deviations per Laser Notice No. 50, July 2001.

The JDS Uniphase Stressed Eye Generator provides a cost effective IEEE Std. 802.3ae™ Stressed Eye reference for manufacturing and research and development (R&D) compliance testing. This optical transmitter can operate with data rates ranging from 155 Mb/s to 10.71 Gb/s and provides adjustable extinction ratio control and selectable inter-symbol-interference paths.

The Stressed Eye Generator accepts sinusoidal interference rates from 2.0 GHz to 0.1 GHz. All features are accessible via the front panel (no PC required) or remotely by GPIB with SCPI compatibility.

The Stressed Eye Generator is available at 850 nm, 1310 and 1550 nm wavelengths.

CLASS 1 LASER PRODUCT
(IEC 60825-1, 2002)

INVISIBLE LASER RADIATION
AVOID EXPOSURE TO BEAM
CLASS 3R LASER PRODUCT
(IEC 60825-1, 2002)
700-1400 NM

NORTH AMERICA: 800 498-JDSU (5378) | WORLDWIDE: +800 5378-JDSU | WEBSITE: www.jdsu.com

Continued

Data Source Requirements

The JDS Uniphase 10 Gb/s Reference Transmitter has several features that allow the user to build a stressed eye per IEEE Std. 802.3ae™ Clause 52. The transmitter provides the user with the ability to insert AM interference and provides a switched path for OMA calibration, insertion of an internal 4th order low pass Bessel Thomson filter or externally supplied filter.

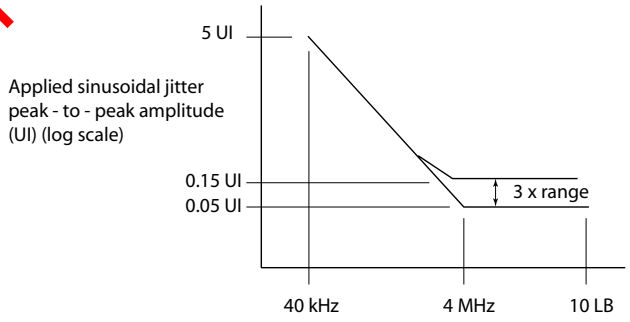
NOTE: The 10 Gb/s Reference Transmitter does not supply timing jitter for the stressed eye test. Timing jitter is supplied by the data source.

The following are the requirements of the data source for compliance to IEEE Std. 802.3ae™ :

- Wideband Jitter p-p < 0.2 UI
- Data input amplitude 0.5 to 1.5 V p-p
- T_{rise} and T_{fall} < 30 ps

Data source must be able to add 0.05 to 0.15 UI of added sinusoidal jitter p-p at the frequency range shown below via an external clock input:

- Frequency range of jitter: 40 kHz to 10X Loop-Bandwidth of DUT (< 80 MHz)



Mask of the sinusoidal component of jitter tolerance (informative)

Specifications

Parameter	Specification		
General			
Optical wavelength	850 ± 10 nm	1310 ± 20 nm	1550 ± 20 nm
Root mean square (RMS) spectral width	< 0.45 nm	< 0.1 nm	< 0.1 nm
Optical fiber	Multimode fiber (MMF) 50/125	Single-mode fiber (SMF) 9/125	Single-mode fiber (SMF) 9/125
Operational data rate	155 Mb/s to 10.71 Gb/s		
Data patterns	PRBS 2^{31} - 1, 2^{7}-1, $A_nA_iA_nA_i$, $B_nB_iB_nB$, (11110000)		
Data input (internal AC coupled)	0.5 V to 1.5 V		
PRESET button	Selects factory default OMA mode setting of 3.5 dB ER and OMA mode		
Operator interface	Front panel LCD interface SCPI compatible GPIB command set		
Reference Mode[1]			
Average optical output power	> - 1 dBm	> - 1 dBm	> - 1 dBm
Extinction ratio at 10.3125 Gb/s, Pseudo-random binary sequence (PRBS) 2^{31}-1 bit stream	Adjustable from 6 to 10 dB		
Rise and fall time (20 to 80 %)	<35 ps[2]	< 30 ps	< 30 ps
Vertical eye closure penalty (1% center region of eye)	< 1.0 dB[3]	< 0.5 dB	< 0.5 dB
Eye mask margin	15 %, using IEEE Std. 802.3ae™ -2002 Eye Mask definition, PRBS 2^{31}-1, 1000 waveforms		
Relative intensity noise (RIN)	< -136 dB/Hz		
Jitter	< 0.2 UI p-p (input signal <0.1 UI p-p jitter)		
Internal Stressed Eye Mode[1]			
Vertical eye closure penalty resulting from selection of internal ISI filter 10.3125 Gb/s	>2.33 dB	>1.47 dB	>1.80 dB
Extinction ratio at 10.3125 Gb/s, PRBS 2^{31}-1 bit stream	Adjustable from 3 to 4 dB		
Sinusoidal interferer input frequency range	100 MHz to 2.0 GHz		
Sinusoidal interference input level	< 20 dBm		
External ISI filter port	SMA female connectors for passive devices only - apply no AC or DC voltages		
General			
Input voltage	100 to 240 V AC, 50 to 60 Hz		
Power consumption	75 V A maximum		
Operating temperature	0 to 50 °C		
Storage temperature	- 30 to 60 °C		
Humidity	maximum 95 % RH non-condensing from 0 to 45 °C		
Dimensions (W x H x D)	13.2 x 44.9 x 50.0 cm (19 inch x 3U x 20 inch)		
Weight	12.4 kg		

1. Specification guaranteed at these data rates: 9.95328, 10.3125, 10.51875 Gb/s.
2. IEEE Std. 802.3ae Reference Transmitter rise and fall time (20 to 80 %) specification is < 30 ps.
3. IEEE Std. 802.3ae Reference Transmitter vertical eye closure penalty (1% center region of eye) specification is < 0.5 dB.

Ordering Information

For more information on this or other products and their availability, please contact your local JDS Uniphase account manager or JDS Uniphase directly at 1-800-498-JDSU (5378) in North America and +800-5378-JDSU worldwide or via e-mail at sales@jdsu.com.

Sample: OPTX10+1O13FP

OPTX10+1 **O** ☐ ☐ ☐☐

Code	Wavelength
1	1550 nm
3	850 nm
4	1310 nm

Code	Connector Type
FP	FC/PC

Code	Fiber Type (µm)
1	MM 50/125 (850 nm wavelength only)
3	SM 9/125

Polarization Mode Dispersion Emulator

PMD Series

Key Features

- High accuracy generation of PMD
- Repeatability of ± 0.02 ps
- PE3 emulation range > 125 ps
- PE4 emulation range > 250 ps
- GPIB and RS-232 remote control

Applications

- Testing PMD effects on systems
- Calibration of PMD measuring equipment

Safety Information

Complies to CE requirements plus UL3101-1 and CAN/CSA-C22.2 No. 1010.1

The JDS Uniphase Polarization mode dispersion (PMD) Emulator produces a controlled amount of differential group delay (DGD). It is used for fiberoptic systems testing, calibration of PMD measurement instruments and PMD sensitivity measurements in high-speed optical transmission systems.

The instrument separates the incoming light into two discrete polarization paths. One of the paths passes through an optical delay element, the other through a matching attenuator, and they are recombined at the output of the unit. The optical delay element allows precise control of the time delay between the two polarization state paths, the DGD. The state of polarization at the output of the instrument is not controlled.

The emulator is a programmable instrument that can be controlled from the front panel or by the GPIB and RS-232 interfaces.

Specifications

Parameter	PE3	PE4
Operating wavelength range	1250 to 1700 nm	
Polarization mode dispersion (PMD) emulation range	- 30 to 125 ps	- 50 to 250 ps
PMD emulation accuracy at 0 ps setting[1]	± 0.1 ps	
PMD emulation resolution	0.002 ps nominal	
PMD emulation repeatability[2]	± 0.02 ps	
PMD emulation relative accuracy[3]	± (0.02 ps + 0.05% of PMD)	
Insertion loss (IL)[1, 2, 4]	- 30 to 0 ps ≤ - 3.0 dB - 0 to 30 ps ≤ - 2.5 dB 30 to 125 ps ≤ - 3.0 dB	- 50 to 0 ps ≤ - 4.0 dB - 0 to 100 ps ≤ - 3.0 dB 100 to 250 ps ≤ - 4.0 dB
Polarization dispersion loss (PDL)[1,3]	- 30 to 0 ps ≤ - 0.5 dB - 0 to 30 ps ≤ - 0.2 dB 30 to 125 ps ≤ - 0.5 dB	- 50 to 0 ps ≤ - 1.0 dB - 0 to 100 ps ≤ - 0.5 dB 100 to 250 ps ≤ - 1.0 dB
Return loss (RL)	> 45 dB	
IN/OUT fiber type	single-mode (SM) 9/125 µm fiber with bulkhead FC connectors	
Input voltage	100 to 240 V AC, 50 to 60 Hz	
Power consumption	100 V A maximum	
Control	GPIB and RS-232 interfaces	
Operating temperature	0 to 40 °C	
Storage temperature	- 40 to 60 °C	
Humidity	maximum 95 % non condensing	
Dimensions (W x H x D)	21.2 x 8.9 x 35.5 cm	
19-inch (48.26 cm) rackmounting	2U high, half-rack width	
Weight	4 kg	

1. At 1550 nm and 25 ± 5 °C.
2. At constant temperature.
3. Excluding connectors.

Ordering Information

For more information on this or other products and their availability, please contact your local JDS Uniphase account manager or JDS Uniphase directly at 1-800-498-JDSU (5378) in North America and +800-5378-JDSU worldwide or via e-mail at sales@jdsu.com.

Sample: PE3+1FP

PE □ + 1 □□

Code	Model
3	PE3
4	PE4

Code	Connector Type
FP	FC/PC
FA	FC/APC

Optical Delay

Key Features

- High accuracy
- Repeatability of ± 0.02 ps
- HD3 optical delay range of 170 ps
- HD4 optical delay range of 350 ps
- GPIB and RS-232 remote control

Applications

- Integration into polarization maintaining fiber (PMF) output test systems
- Phase control in testing reflection effects on transmitters
- Clock synchronization

Safety Information

Complies to CE requirements plus UL3101-1 and CAN/CSA-C22.2 No. 1010.1

The JDS Uniphase Optical Delay instrument produces a controlled amount of delay by restricting the path length and the optical delay time of transmitted light in an optical fiber. This instrument can be used in a polarization mode dispersion (PMD) emulation system or in a PMD interferometric measurement system to vary the path length in one optical branch of the system. It can also be used to vary the modulation phase of reflections for the testing of effects on transmitters.

The insertion loss (IL) is optimized to be lowest at the center of travel. The display is factory set to read 0 ps at this point.

The instrument is available with single-mode (SM) fiber or PMF. The input and output FC/PC or FC/APC connectors are front-panel mounted. A zero-offset function allows the user to set the display to 0 ps at any path time setting. The Optical Delay is a programmable instrument that can be controlled from the front panel or by the GPIB and RS-232 interfaces.

Specifications

Parameter	HD3	HD4
Wavelength range	1250 to 1700 nm	
Optical delay range[1]	- 85 to 85 ps	- 175 to 175 ps
Optical delay accuracy[2]	± (0.02 ps + 0.5 % of delay)	
Optical delay resolution	0.002 ps nominal	
Optical delay repeatability[3]	± 0.02 ps	
Insertion loss (IL)[1, 2, 4]	- 15 to 15 ps 1.5 dB	- 30 to 30 ps 2.5 dB
	- 50 to 50 ps 1.8 dB	- 100 to 100 ps 3.0 dB
	- 85 to 85 ps 2.0 dB	- 175 to 175 ps 4.0 dB
IL variation[1, 3]	- 15 to 15 ps 0.2 dB	- 30 to 30 ps 0.5 dB
	- 50 to 50 ps 0.5 dB	- 100 to 100 ps 1.0 dB
	- 85 to 85 ps 1.0 dB	- 175 to 175 ps 2.0 dB
Return loss (RL)[4, 5]	> 55 dB	
Polarization dependent loss (PDL)	0.1 dB	
Extinction ratio	> 20 dB polarization maintaining fiber (PMF)version	
Fiber type	Single-mode (SM) 9/125 µm fiber with bulkhead FC connectors	
	SM or PMF	
Input voltage	100 to 240 V AC, 50 to 60 Hz	
Power consumption	100 V A maximum	
Control	GPIB and RS-232 interfaces	
Operating temperature	0 to 40 °C	
Storage temperature	- 40 to 60 °C	
Humidity	maximum 95 % non condensing	
Dimensions (W x H x D)	21.2 x 8.9 x 35.5 cm	
19-inch (48.26 cm) rackmounting	2U high, half-rack width	
Weight	4 kg	

1. The IL is optimized to be lowest at the center of travel. The display is factory set to read 0 ps at this point. A different optimization point is available on a custom basis.
2. At 1550 nm and 25 ± 5 °C.
3. At a constant temperature.
4. Excluding connectors.
5. Total of discrete reflections; does not include distributed reflection in fiber.

Ordering Information

For more information on this or other products and their availability, please contact your local JDS Uniphase account manager or JDS Uniphase directly at 1-800-498-JDSU (5378) in North America and +800-5378-JDSU worldwide or via e-mail at sales@jdsu.com.

Sample: HD3+1SFA

HD □ **+ 1** □ □□

Code	Mode
3	HD3 (170 ps range)
4	HD4 (350 ps range)

Code	Connector Type
FP	FC/PC
FA	FC/APC

Code	Fiber Type (µm)
P	PM[1]
S	SM

1. Only with FC/PC connector type.

NORTH AMERICA: 800 498-JDSU (5378) | WORLDWIDE: +800 5378-JDSU | INSTRUMENTATION LITERATURE REQUEST: instruments@jdsu.com

Benchtop Broadband Source

BBS Series

Key Features

- Choice of wavelengths (C- band and L- band)
- Flattened output power spectrums
- High output power density
- High spectral stability
- Optional quad outputs

Applications

- Optical component spectral tests
- Systems compliance tests
- Optical measurement systems
- Sensors and imaging

Safety Information

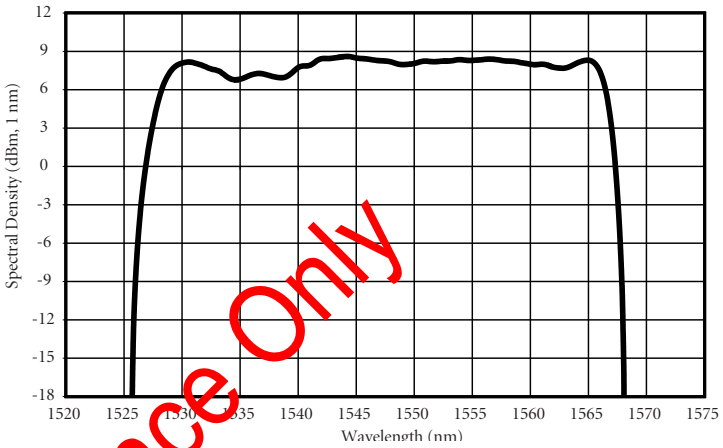
Complies to CE requirements plus UL3101-1 and CAN/CSA-C22.2 No. 1010.1 Meets the requirements of Class 3B in standard IEC 60825-1(2002) and complies with 21CFR1040.10 except deviations per Laser Notice No. 50, July 2001.

The JDS Uniphase Benchtop BBS series provides a wide wavelength and high output power source within the 1525 to 1610 nm window. Its superior performance is achieved by pumping erbium-doped fiber to generate amplified spontaneous emission combined with specialized optical filters to achieve optimal flatness over its operating wavelength range.

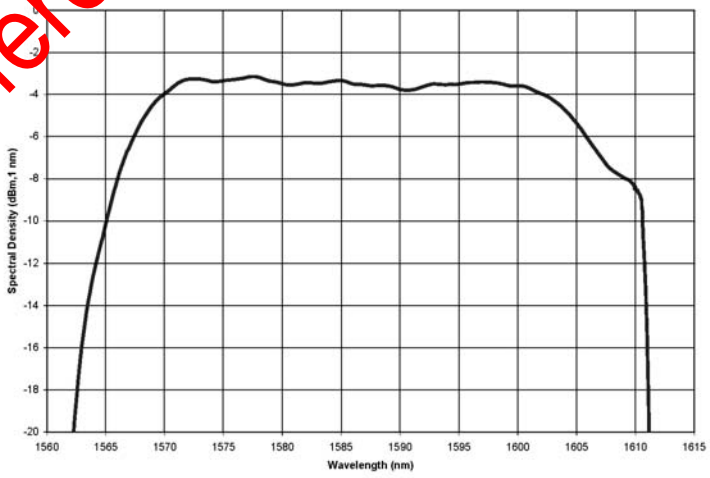
Through optimization of spectral power density, spectral uniformity and optical stability, the broadband source maximizes your capabilities of optical component spectral measurements and systems compliance tests both in manufacturing and research and development (R&D) environments.

The Benchtop models provide specialized variants and optical performance not available in the Multiple Application Platform (MAP) product line. Additional Benchtop BBS models are available in the MAP BBS cassette product line.

INVISIBLE LASER RADIATION
AVOID EXPOSURE TO BEAM
CLASS 3B LASER PRODUCT
(IEC 60825-1, 2002)
MAX. 500 mW, 700-1600 nm



BBS1550+2XX30 C-band 250 mW



BBS1590+2XX00 L-band 20 mW

Specifications

Parameter	1550 150 mW Output Power	1550 250 mW Output Power	1590 20 mW Output Power	1590 150 mW Output Power
Test band	C-band		L-band	
Operating wavelength range	1527 to 1568 nm		1565 to 1610 nm	
Spectral gain flatness (maximum)	1.8 dB	2.5 dB	1.8 dB	4.5 dB
Gain flattened range	1529 to 1565 nm		1570 to 1603 nm	
Total output power stability[3]	0.02 dB			
Output isolation (minimum)	45 dB			
Input voltage	100 to 240 V AC, 50 to 60 Hz			
Power consumption	90 V A maximum			
Operating temperature	0 to 50 °C			
Storage temperature	- 40 to 70 °C			
Humidity	maximum 95 % RH non condensing from 0 to 45 °C			
Dimensions (W x H x D)	21.2 x 8.9 x 35.5 cm			
Weight	< 4 kg			

1. Measured at 1547 nm (C-band) at 23 °C.
2. Measured at 1586 nm (L-band) at 23 °C.
3. Over one hour at 23 °C, after one hour of warm-up.

Ordering Information

For more information on this or other products and their availability, please contact your local JDS Uniphase account manager or JDS Uniphase directly at 1-800-498-JDSU (5378) in North America and +800-5378-JDSU worldwide or via e-mail at sales@jdsu.com.

Sample : BBS1550+2FP02

BBS □□□□ + 2 □□ □ □

Code	Model
1550	C-band, 1527 to 1568 nm
1590	L-band, 1565 to 1610 nm

Code	Connector Type
FP	FC/PC
FA	FC/APC
SC	SC/PC
SU	SC/APC

Code	Output power
0	Standard output power (available for BBS1590)
2	150 mW output power (available for BBS1550 and BBS1590)
3	250 mW output power (available for BBS1550)

Code	Connectors
0	Standard one output connector
4	Optional four output connectors for BBS1550

Standard Accessories

Part Number	Description
ED000899-A-00	Standard 19-inch rackmount kit

Optional Accessories

Part Number	Description
ED000899-A-01	Rackmount kit (Japan)

Meters

JDS Uniphase manufactures unique meters capable of testing critical characterization parameters such as insertion loss (IL), return loss (RL) or backreflection and polarization dependent loss (PDL). Our precision-built backreflection meters, multichannel backreflection meters and polarization dependent loss multimeters form an essential part of any testing solution.

JDS Uniphase Backreflection Meters are measurement instruments for single-mode or multimode testing. These meters are extremely stable due to their superior optical design.

The Backreflection Meter is ideal for connector manufacturing testing, due to its compact size and integrated rechargeable battery.

An integrated optical switch distinguishes the Multichannel Backreflection Meter. The switch is included in the meter calibration, so that the RL measurement range of 75 dB is maintained. The meter is an excellent choice for high-volume production testing where there is a mix of connector types. It is ideal for testing multiple connector port devices, splitters, and ribbon cables.

The JDS Uniphase PDL Multimeters simultaneously measure PDL and IL in less than two seconds and also measure RL. The PDL and IL are calculated using the Mueller method, standardized under IEC (613)00-3-12, which makes the multimeters ideal for the manufacturing of PDL-sensitive components (such as isolators, dense wavelength division multiplexers (DWDMs), fiber bragg gratings (FBG), optical circulators, switches, attenuators, and couplers).

Included in This Section

Backreflection Meter

Key Features

- Wide wavelength range
- IL and backreflection capability
- Typical backreflection power sensitivity of - 75 dB
- IL and power measurements to - 80 dBm
- Convenient foot pedal for data logging
- Direct display of measured backreflection, power, or insertion loss
- Compensation for extraneous backreflection for accurate backreflection measurements
- Calibration can be verified using calibrated reference jumpers
- User-calibration mode
- Transit case for safer and easier portability

Applications

- Connector backreflection/loss testing
- Component testing
- Installation verification
- Quality assurance acceptance testing

Safety Information

Complies to CE requirements plus UL3101-1 and CAN/CSA-C22.2 No. 1010.1 Meets the requirements of Class 1 in standard IEC 60825-1(2002) and complies with 21CFR1040.10 except deviations per Laser Notice No. 50, July 2001.

CLASS 1 LASER PRODUCT
(IEC 60825-1, 2002)

The JDS Uniphase Backreflection Meter is a convenient, portable, direct-display instrument used for the measurement of backreflection, insertion loss, and power of connectors, components, and systems. With a single output port, the meter is ideal for jumper manufacturers.

The meter can be equipped with one or two built-in laser sources. Sources available are: 850, 1310 and 1550 nm for multimode meters, and 980, 1310, 1480, 1490, 1550, 1625 and 1650 nm for single-mode meters.

The use of an FC/APC ultra-low backreflection connector on the output port enables the use of hybrid jumpers to accommodate measurements with various connector types without compromising the backreflection measurement range. When a device under test (DUT) is connected to the jumper and the DUT output is terminated, the backreflection of the DUT is displayed. The meter's superior optics are very stable at low backreflection levels. Insertion loss (IL) and power can be measured to - 80 dBm.

Other features include compensation for extraneous backreflection, user-adjustable calibration, an internal rechargeable battery for field portability, a transit carrying case, and a convenient foot pedal for data logging to a computer or serial printer via the instrument's serial port.

JDS Uniphase

BACKREFLECTION METER

Specifications

Parameter	Single-mode (SM)		Multimode (MM)
	(5/125 µm)	(9/125 µm)	(50/125 µm and 62.5/125 µm)
Operating wavelengths	980 ± 10 nm	1310, 1480, 1490, 1550, 1625, 1650 ± 10 nm	850, 1310, 1550 ± 20 nm
Backreflection range	0 to - 65 dB[1]	0 to - 75 dB	0 to - 40 dB[1]
Relative accuracy - backreflection	± 0.4 dB[2]		± 0.7 dB[3]
Detector type	2 mm InGaAs		3 mm InGaAs
Power range	0 to - 80 dBm		0 to - 60 dBm
Absolute power accuracy	± 0.25 dB (typical) at - 10 dB[4,5]		± 0.25 dBm (typical) at - 10 dBm[5]
Relative accuracy - power	± 0.05 dB (< 5 dB loss), ± 0.15 dB (> 5 dB loss)[4]		± 0.15 dB[5,6]
Remote interface	RS-232 (GPIB optional)		
Input voltage	100 to 240 V AC, 50 to 60 Hz		
Power consumption	30 V A maximum		
Display	16 character LCD		
Operating temperature	0 to 40 °C		
Storage temperature	- 40 to 70 °C		
Humidity	Maximum 95 % RH from 0 to 40 °C		
Dimensions (W x H x D)	26 x 11 x 26 cm		
Weight	4 kg		

1. Reduced backreflection accuracy in the last 10 dB of range based on termination effectiveness. Depending on the measurement setup, measurements with lower levels are possible at reduced accuracy.
2. For a typical application add ± 0.4 dB for readings between - 60 and - 67 dB. Add ± 0.7 dB for readings between - 67 and - 72 dB. Add ± 1.5 dB for readings between - 72 and - 75 dB.
3. Following the user-calibration procedure at the recommended interval. For simple reflections, such as flat-end connectors.
4. Add ± 0.1 dB between - 70 and - 80 dBm.
5. Immediately after performing a dark measurement. Not including the 1650 nm source.
6. Add ± 0.1 dB between 0-3 dBm and between - 35 and - 40 dBm.

Ordering Information

For more information on this or other products and their availability, please contact your local JDS Uniphase account manager or JDS Uniphase directly at 1-800-498-JDSU (5378) in North America and +800-5378-JDSU worldwide or via e-mail at sales@jdsu.com.

Sample: RM3750+1FA7

RM3 □ 5 0 + 1 □□ □

Code	Light Source Wavelength (nm)
1	850
2	980
3	1310
4	1480
5	1550
6	1625
8	1650
9	850/1310
7	1310/1550
A	1550/1625
B	1550/1650
C	1480/1550
H	1490/1550
J	1490/1625
M	1310/1625

Code	Connector Type
FA	FC/APC
SU	SC/APC

Code	Fiber Type (µm)
8	5/125
7	9/125
1	50/125
2	62.5/125

Multichannel Backreflection Meter

Key Features

- SM and MM models available
- Measurements at 850, 1310, 1480, 1490, 1550, 1625 or 1650 nm
- Integrated switch included in the calibration
- Multidisplay mode

Applications

- SM fiber connector and component testing
- Ribbon fiber measurements
- MM fiber connector testing

Safety Information

Complies to CE requirements plus UL3101-1 and CAN/CSA-C22.2 No. 1010.1. Meets the requirements of Class 1 in standard IEC 60825-1(2002) and complies with 21CFR1040.10 except deviations per Laser Notice No. 50, July 2001.

CLASS 1 LASER PRODUCT
(IEC 60825-1, 2002)

The JDS Uniphase Multichannel Backreflection Meter performs a wide range of single-mode (SM) or multimode (MM) return loss (RL) and loss measurement functions, ranging from single component testing to automated multifiber testing. The primary functions of high sensitivity RL measurements and power measurements can be augmented by adding multiple output ports and multiple internal light sources.

The meter is available with 1, 4, 8, 12, 16, 20 or 24 output ports. A multidisplay mode lets the viewer see multiple test results at a glance.

The meter is used for single fiber and ribbon fiber connector measurements. The use of hybrid jumpers allow a quick change of the connector type without limiting the RL range. The meter is also available with 2 or 3 internal sources for measurements at 850, 1310, 1480, 1490, 1550, 1625 or 1650 nm.

The 2-mm InGaAs detector is particularly useful for high sensitivity single fiber applications. The 5-mm Ge detector is an economical solution for measurements of ribbon fiber connectors and can accurately measure connectors with up to 8 MM and 12 SM fibers. The large surface 10-mm InGaAs detector is ideal for measurements of larger fiber count ribbon connectors, and can be used with wavelengths extending in the L-band. One FC detector adapter is supplied with the unit, and other adapters, such as MTP/MPO or MU for ribbon fiber connector types, are also available.

The meter is supplied with one calibrated hybrid jumper for calibration purposes and one hybrid test jumper for measurement purposes. Both jumpers are equipped with an FC/APC connector on one end (for the output port of the meter) and an FC/PC connector on the other end. Uncalibrated hybrid jumpers for measurements with other connector types are also available.

Specifications

Parameter	Single-mode (SM)			Multimode (MM)		
Operating wavelengths	1310, 1480, 1490, 1550, 1625, 1650 ± 10 nm			850, 1310, 1550 ± 20 nm		
Outputs	1, 4, 8, 12, 16, 20 or 24					
Detector type	2 mm InGaAs	5 mm Ge[8]	10 mm InGaAs	3 mm InGaAs	5 mm Ge[8]	10 mm InGaAs
Power range[1]	3 to - 80 dBm	3 to - 40 dBm	- 5 to - 40 dBm	3 to - 60 dBm	3 to - 40 dBm	5 to - 40 dBm
Relative power accuracy[5, 9]	± 0.15 dB[6]			± 0.15 dB[7]		
Relative power accuracy (5 dB range)[5, 9]	± 0.05 dB[6]			± 0.15 dB[7]		
Backreflection range[1, 2, 9]	0 to - 75 dB			0 to - 40 dB		
Relative backreflection accuracy[3, 9]	± 0.4 dB[4]			± 0.7 dB		
Relative backreflection accuracy (5 dB range)[3, 9]	± 0.3 dB[4]			± 0.7 dB		
Absolute power accuracy	± 0.25 dB typical at - 10 dBm					
Backreflection resolution	0.1 dB					
Power resolution	0.01 dB					
Input voltage	100 to 240 V AC, 50 to 60 Hz					
Power consumption	80 V A maximum					

1. Depending on the measurement setup, measurements with lower levels are possible at reduced accuracy.
2. Reduced backreflection accuracy in the last 10 dB of range based on termination effectiveness. Depending on the measurement setup, measurements with lower levels are possible at reduced accuracy.
3. Following the user-calibration procedure at the recommended interval.
4. For a typical application, add ± 0.4 dB for readings between - 60 and - 67 dB. Add ± 0.8 dB for readings between - 67 and - 72 dB. Add ± 1.5 dB for readings between - 72 and - 75 dB.
5. Immediately after performing a dark measurement.
6. Add ± 0.1 dB between 0 and 3 dBm and in the last 10 dB of the range.
7. Add ± 0.1 dB between 0 and 3 dBm and in the last 5 dB of the range.
8. 5 mm Ge detector can accurately measure ribbon fiber connectors with up to 8 MM or 12 SM fibers at wavelengths up to 1600 nm.
9. Measured at ambient temperature ± 3 °C. Not including 1650 nm source.

Ordering Information

For more information on this or other products and their availability, please contact your local JDS Uniphase account manager or JDS Uniphase directly at 1-800-498-JDSU (5378) in North America and +800-5378-JDSU worldwide or via e-mail at sales@jdsu.com.

Sample: RX3070+1122FA7

RX30 □ **0+1** □□ □ □□ □

Code	Source Wavelength (nm)
1	850
3	1310
4	1480
5	1550
6	1625
8	1650
9	850/1310
7	1310/1550
A	1550/1625
B	1550/1650
C	1480/1550
D	1310/1480/1550
E	1310/1550/1625
F	1480/1550/1625
G	850/1310/1550
H	1490/1550
J	1490/1625
K	1310/1490/1550
L	1490/1550/1625
M	1310/1625

Code	Number of Output Channels
01	1 output channel
04	4 output channels
08	8 output channels
12	12 output channels
20	20 output channels
16	16 output channels
24	24 output channels

Code	Connector Type
FA	FC/APC
SU	SC/APC

Code	Fiber Type (µm)
7	9/125
1	50/125
2	62.5/125

Code	Detector Type
1	2 x 3 mm InGaAs
2	5 mm Ge
3	10 mm InGaAs

Optional Accessories

See Accessories document/section for available detector adapters.

Polarization Dependent Loss Multimeter

PDL Series

Key Features

- Uses the Mueller method
- Rapidly changes from PDL and IL to RL measurements
- Measurements take only a few seconds
- Displays IL and PDL simultaneously
- External tunable source capability
- GPIB and RS-232 remote control
- Integrated PDL standard source

Applications

- Passive component qualifications
- Optical attenuator specifications
- Optical switch specifications

Safety Information

Complies to CE requirements plus UL3101-1 and CAN/CSA-C22.2 No. 1010.1 Meets the requirements of Class 1 in standard IEC 60825-1(2002) and complies with 21CFR1040.10 except deviations per Laser Notice No. 50, July 2001.

CLASS 1 LASER PRODUCT
(IEC 60825-1, 2002)

The JDS Uniphase Polarization Dependent Loss (PDL) Multimeter is the fastest and most accurate multimeter available. It measures PDL of single-mode (SM) fiberoptic components using either an internal laser or an external source. The multimeter measures the loss of a device under test (DUT) for four independent input polarization states. The PDL and the average loss over all polarization states are calculated using the Mueller matrix, internationally standardized under IEC (613)00-3-12.

The multimeter easily and rapidly changes from measuring PDL and insertion loss (IL) to measuring return loss (RL) or power. The PDL and IL are measured and displayed simultaneously in less than two seconds.

The multimeters have a sophisticated optical design that compensates for changes in optical power at the internal reference detector. The design ensures accurate loss measurements regardless of drift in the source power or the coupling efficiency of the input light through the polarization state controller. The integrated PDL standard source is particularly convenient for verifying the meter's calibration. An external tunable laser or two fixed laser sources can be selected for various wavelength measurements. The multimeter is ideal for PDL-sensitive components, such as isolators, dense wavelength division multiplexers (DWDMs), fiber Bragg gratings (FBGs), optical circulators, switches, attenuators, couplers and other devices for which high test accuracy and optimum production speed are crucial.

Continued

Two models are available: a single internal laser source model and a dual internal laser source model. The internal lasers available for the single internal laser source are: 980, 1310, 1480, 1550, 1625, or 1650 nm. The dual internal laser sources available are: 1310/1550, 1550/1625, 1550/1650, 1480/1550 nm. Other accessories, such as detector adapters and hybrid jumpers, are also available.

Specifications

Parameter	PS30 X 0 and PS36 X 0 Models		PS3 X 20 Models
Built-in laser type Fabry-Perot	1310,1480,1550,1625,1650 ± 10nm		980 ± 10nm
Fiber type	9/125 µm single-mode (SM)		5/125 µm Flexcor
1060IEC 61300-3-12	Polarization dependence of attenuation of a SM fiberoptic component: matrix calculation method		
Polarization dependent loss (PDL) and average loss measurements (ALM)			
Resolution	0.01, 0.001, or 0.0001 dB		
Optimization	1550 nm	1310 nm	980 nm
Absolute accuracy			
PDL 960 to 1060 nm (maximum)	N/A	N/A	± (0.005 dB + 5 % of PDL) dB
PDL 960 to 1060 nm (typical)	N/A	N/A	± (0.002 dB + 1 % PDL) dB
PDL 1455 to 1665 nm (maximum)	± (0.005 dB + 5 % of PDL) dB	± (0.010 dB + 5 % of PDL) dB	N/A
PDL 1455 to 1665 nm (typical)	± (0.002 dB + 1 % of PDL) dB	± (0.004 dB + 2 % of PDL) dB	N/A
PDL 1250 to 1350 nm (maximum)	± (0.010 dB + 5 % of PDL)	± (0.005 dB + 5 % of PDL) dB	N/A
PDL 1250 to 1350 nm (typical)	± (0.004 dB + 2 % of PDL) dB	± (0.002 dB + 1 % of PDL) dB	N/A
L_{av} insertion loss (IL)	± (0.05 dB + 2 % of L_{av}) dB		
Power	± 0.25 dB at - 10 dBm		
Repeatability			
PDL	± (0.001+ 5 % of PDL) dB		
L_{av} accuracy	± (0.001+ 2 % of L_{av}) dB		
Dynamic range[1]			
PDL range[2]	0 to 5 dB		
L_{av} IL (InGaAs 3 mm)	> 60 dB		
General			
Input voltage	100 to 240 V AC, 50 to 60 Hz		
Power consumption	100 V A maximum		
Rackmounting 19-inch (48.26 cm)	2 U high, half-rack width		
Operating temperature	0 to 40°C		
Storage temperature	- 40 to 60 °C		
Humidity	maximum 95 % up to 40 °C decreasing 5 % per °C from 40 to 60 °C		
Dimensions (W x H x D)	21.2 x 8.9 x 35.5 cm		
Weight	4 kg		
(For multimeters with return loss (RL) options only) - PS36 x 0			
Resolution	1, 0.1, or 0.01 dB		
Accuracy	± 1.0 dB		
Repeatability	± 0.7 dB		
Return loss (RL) range for - 15 dBm output power[3]	> 60 dB		

1. A measurement taken with output power less than - 25 dBm for the internal source and - 30 dBm (dynamic range for - 10 dBm at external input with the input fiber to the multimeter optimized for the most power) for an external source present at the multimeter's front panel detector can reduce resolution and/or accuracy.
2. Higher PDLs can be measured with reduced accuracy.
3. Output power is about 3 dB higher in RL mode than in power mode. Therefore, full RL range is obtained when the measured output power in power mode is - 18 dBm.

Ordering Information

For more information on this or other products and their availability, please contact your local JDS Uniphase account manager or JDS Uniphase directly at 1-800-498-JDSU (5378) in North America and +800-5378-JDSU worldwide or via e-mail at sales@jdsu.com.

Sample: PS3650+25

PS3 ☐ ☐ 0 + 2 ☐

Code	Optical RL
0	Without
6	With

Code	Light Source Wavelength (nm)
0	Without
2	980
3	1310
4	1480
5	1550
6	1625
7	1310/1550
8	1650
A	1550/1625
B	1550/1650
C	1480/1550
H	1490/1550
J	1490/1625
M	1310/1625

Code	Optimized Wavelength (nm)
2	980[1]
3	1310
5	1550[2]

1. Only for models with a 980 nm internal source.
2. Standard.

The multimeter includes: two FC/APC connectors (one at the OUT port and another at the IN port); an FC detector adapter and detector cap for the front panel detector; one FC/APC-FC/PC test jumpers and, for the RL option, a calibrated jumper; an AC power cord; and a 19-inch rackmount kit. The GPIB and RS-232 interfaces are standard.

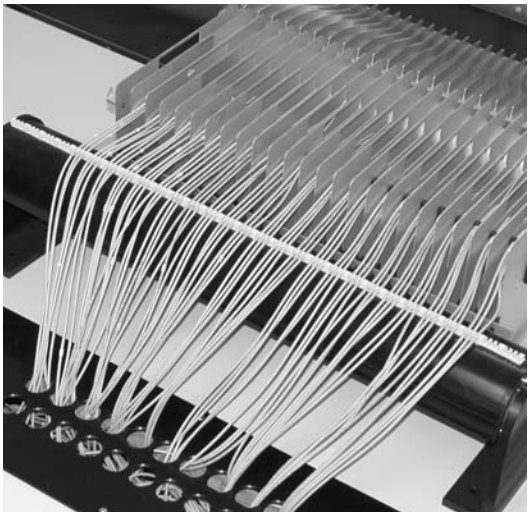
Environmental Test Systems

Long term reliability and environmental testing of optical components and qualification to Telcordia specifications is used by manufacturers in the design process, and is required by purchasers as part of the incoming inspection process to ensure that components meet specifications. This type of testing is also useful for product integrity auditing and quality control. The Optical Component Environmental Test System (OCETS) addresses these considerations.

By adding the SWS2000 high performance dense wavelength division multiplexing (DWDM) tester to the OCETS and switching to the SWS-EMA (Environmental Measurement Application) software package, the SWS can utilize the high performance, switching matrix of the OCETS to extend its own performance to the reliability and environmental testing of wavelength division multiplexing (WDM) and DWDM components, which require highly resolved wavelength insertion loss and polarization dependent loss testing.

Included in This Section

Environmental Test Systems



Key Features

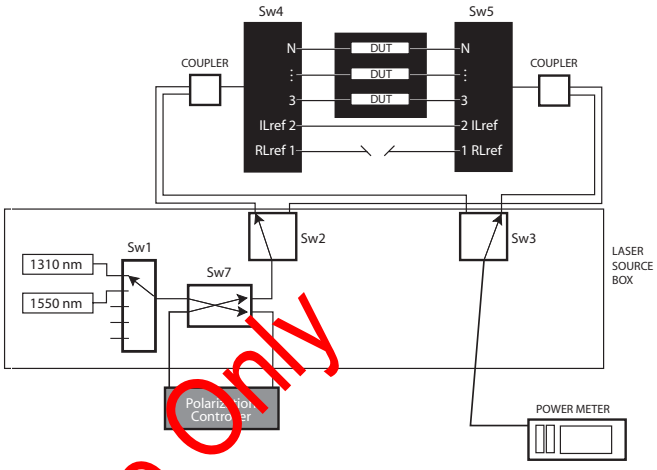
- Up to 160 device channels
- Unattended long term operation
- Very high repeatability
- Measures parameters required in Telcordia GR-326-CORE, GR-910-CORE, GR-1209-CORE, GR-1221-CORE
- Tests all classes of passive optical components (broadband to dense wavelength division multiplexing (DWDM))
- Ultra-low return loss (RL) (65 dB) option
- Polarization dependent loss (PDL) measurement option
- Multimode (MM) fiber option

In order to be incorporated into modules and transmission systems, fiberoptic manufacturers must show that their devices meet the relevant standards for performance and reliability. Standards vary between industries, but some element of testing over an extended temperature and humidity range is required.

All standards require that a representative number of samples of the device be subjected to a program of environmental challenges, high and low temperature storage, and temperature cycling. An environmental testing program might consist of 3 to 6 stages of temperature/humidity challenges. The device characteristics are required to be measured before and after each stage, and in some cases continuously or at intervals during the stage. Removing all the devices from the environmental chamber for optical measurements is simply not practical. It is this measurement requirement for which the JDS Uniphase Environmental Test Systems have been designed.

Our Environmental Test Systems are integrated automated test facilities intended for long-term reliability testing of optical components under environmental stress conditions, such as those called for in Telcordia specification GR-326-CORE, GR-910-CORE, GR-1209-CORE and GR-1221-CORE. Components under test are subjected to a range of environmental conditions in a test chamber, usually over a period of many weeks. Chamber conditions are logged at specified time intervals during the test and the required parameters for each device under test (DUT) are measured. User selected parameters are calculated from these responses and are logged along with the time and environmental data.

Continued



Typical Bidirectional Test Configuration

At the core of the Environmental Test System is a pair of high quality JDS Uniphase programmable switches (1 x N configuration). The switches feature an industry-best repeatability of ± 0.003 dB.

These switches, combined with the appropriate source and monitoring hardware plus dedicated software, create a fully automated turnkey measurement facility. An optional polarization controller is installed when PDL measurements are required. A personal computer (supplied) is used to set up the tests, control the measurements and monitor the results. The systems were designed to meet in house JDS Uniphase needs and have been in service for over 10 years.

Two types of Environmental Test systems are available:

- the Optical Component Environmental Test System (OCETS) - suitable for measurements on wideband devices such as splitters, isolators, switches, connectors, jumpers, cable assemblies.
- a high wavelength resolution Swept Wavelength System - Environmental Monitoring Application (SWS-EMA) version - suitable for all types of DWDM devices, including interleavers, couplers, and etalons.

Both systems fully characterize all required parameters of their respective devices.

The OCETS system can, by addition of a Swept Wavelength System, be converted into the SWS-EMA. In this way, a system, bought for the reliability measurement of relatively simple wideband components, can be upgraded to a system for the measurement of more complex devices needing high wavelength resolution. Once upgraded, the hybrid Environmental Monitoring Systems can easily be switched between the two functions. Both systems route test signals to and from the DUT with JDS Uniphase SC series switches. Such an upgrade would utilize the existing OCETS SC series switch array with a separate dedicated software application package for high wavelength resolution measurements.

Optical Component Environmental Test System

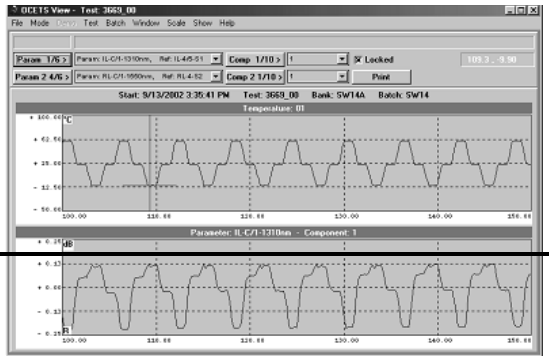
OCETS Series

Key Features

- Automated long-duration testing capability
- Bi-directional testing
- Multi-channel operation
- Multi-wavelength versatility
- Wavelengths include dense wavelength division multiplexing (DWDM), course wavelength division multiplexing (CWDM), or fiber-to-the-home (FTTH)
- Tunable sources or BBS with filter also available
- PDL measurement capability
- Multi-test capability, add more tests while a previous test runs
- Compatibility with many environmental chambers
- High repeatability
- Ultra-low RL to - 65 dB (optional)
- Single-mode (SM) and multimode (MM) capability

The OCETS system uses a combination of up to 4 internal Fabry-Perot lasers, a broadband source/filter or an external source. The light from any of these sources can be routed to either end of each device under test (DUT) in turn. The power meter measures either the insertion loss (IL) through the DUTs, in either direction, or the backreflection from either end. A polarization controller option can be added to enable PDL to be measured. The OCETS software co-ordinates the switches, so that for each batch of DUTs, a line created in the "batch file" will define any combination of wavelength, direction and parameter choices. Software flexibility is built in and multiple lines in the file can be defined to run any number of tests at any of the installed wavelengths on the batch of components; multiple batches are defined when differing sets of tests are required.

A second and subsequent test can be added for additional sets of DUTs, up to the switch capacity limit, while the first test is running. In this way, an environmental chamber running a long term damp heat test on a first prototype, for example, could evaluate the performance of product improvements by installing later devices in the chamber and configuring a second test to run with the same conditions and measurements.



OCETS Software

Safety Information

Complies to CE requirements plus UL3101.1 and CAN/CSA-C22.2 No.1010.1. The Laser Source Box is a Class 1 laser. It is classified per IEC standard 60825-1(2002) and complies with 21CFR1040.10 except deviations per Laser Notice No. 50, July 2001.

INVISIBLE LASER RADIATION
AVOID EXPOSURE TO BEAM
CLASS 3B LASER PRODUCT
(IEC 60825-1, 2002)
MAX. 500 mw, 700-1680 nm

CLASS 1 LASER PRODUCT
(IEC 60825-1, 2002)

Specifications

Optical Component Environmental Test System (OCETS)

Parameter	Single-mode (SM)	Multimode (MM)
Fiber type	9/125 µm fiber, standard 3 mm jacket	50/125 µm or 62.5/125 µm fiber, standard 3 mm jacket
Fiber length	5 m	5 m
Insertion loss (IL) repeatability	± 0.04 dB over 100 hours	± 0.04 dB over 100 hours
IL dynamic range	> 75 dB	> 55 dB
Return loss (RL) repeatability	± 0.5 dB up to 55 dB over 100 hours[1] ± 1 dB up to 65 dB over 100 hours[2]	± 0.5 dB up to 30 dB over 100 hours[1]
Polarization repeatability	± 0.08 dB over 100 hours with fusion splices joining SW4 and SW5 and minimum system configuration	N/A
Measurement timing	IL/RL < 2 s/measurement High RL, PDL < 5 s/measurement	IL/RL < 2 s/measurement
Sources available (up to 4 internal, 1 external)[3]	1310, 1490,1550, 1625 ± 10 nm Fabry-Perot Laser	850, 1310, 1550 ± 20 nm Light emitting diode (LED)
Optical power at device under test (DUT)	> - 10 dBm	> - 25 dBm
Source stability at 23 °C	± 0.01 dB for 20 minutes ± 1 dB for 2000 hours	± 2 nm center wavelength for 2000 hours
General		
Number of channels	160 input, 160 output	
Number of reference channels	2	
Switch lifetime	> 10 million cycles	
Equipment warm-up time	4 hours, can be left on indefinitely with no adverse effects	
Input voltage	220 V AC, 50 Hz and 100 V AC, 60 Hz	
Power consumption	100 V A maximum	
Computer control	PC supplied National Instruments GPIB controller board installed OCETS software and environmental chamber driver installed Print out to any Windows printer Data file format compatible with Windows-based spreadsheets	
Mechanical configuration	The equipment, excluding the computer, is installed in a single full height, 19-inch (48.26 cm) rack W x H x D = 22 x 72 x 36 inches Accessibility to lasers and power meter for periodic calibration Rack fans, replaceable air filter The computer can be located on a table at a maximum distance of 5 m from the equipment rack	
Operating temperature	15 to 30 °C range. Maximum variation range during a test: 3 °C	
Operating humidity	0 to 80 % RH range. Maximum variation range during a test: 15 % RH	

1. Valid for 5 m pigtails with no connectors, or FC/APC connectors. For longer pigtails and /or other connector types, contact JDS Uniphase for specifications.
2. High backreflection version is available for pigtailed fibers up to 5 m or APC connected fibers up to 5 m only.
3. Custom options also available.

Ordering Information

For more information on this or other products and their availability, please contact your local JDS Uniphase account manager or JDS Uniphase directly at 1-800-498-JDSU (5378) in North America and +800-5378-JDSU worldwide or via e-mail at sales@jdsu.com.

Ordering Information for OCETS
Sample: OCETS100+177PHNC

OCETS □□□ + 1 □ □ □ □ □□

Code	Number of Channels
035	35
070	70
105	105
130	130
160	160

Code	Source Wavelength (nm)
9	850/1310
7	1310/1490/1550/1625
V	1310/1490/1550/1625

Code	Fiber Type (µm)
7	9/125
1	50/125
2	62.5/125

Code	PDL
P	With PDL
N	Without PDL

Code	Return Loss Option
S	Standard
H	Ultra-high

Code	Connector Type
FA	FC/APC
NC	No connector

If the configurations available do not meet your performance requirements, please contact our global sales and customer service team to discuss the potential for specialized solutions.

Swept Wavelength System - Environmental Monitoring Application

SWS-EMA Series

Key Features

- Automated long-duration testing capability
- Multi-channel operation - up to 160 channels
- C+L- and S-band range
- SWS transmitters can be used
- Very high wavelength resolution - 1 pm
- High wavelength accuracy ± 2 pm
- High repeatability
- PDL measurement capability
- Ideally suited for multi-channel dense wavelength division multiplexing (DWDM) devices
- User flagged if device fails pre-set criteria

Safety Information

Complies to CE requirements plus UL 3101-1 and CAN/CSA - C22.2 No. 1010.1. The laser source in the Source Optics Controller (SWS20010) is a class 1 laser. The Tunable Laser Source (SWS17101) is a class 3B laser. Both are classified per IEC standard 60825-1(2002) and comply with 21CFR1040.10 except deviations per Laser Notice No. 50, July 2001.

This reliability test system combines the excellent repeatability and reliability of JDS Uniphase switches with the high wavelength resolution and stability of the SWS. The SWS uses a tunable laser. The receiver, which is wavelength synchronized, records the power transmitted by each device under test (DUT) in turn at 3 pm intervals. Two levels of power referencing ensure that short and long term optical power fluctuations or drift do not compromise the measurements.

A polarization controller can be added to enable PDL measurements to be made by Mueller Matrix calculation.

INVISIBLE LASER RADIATION
AVOID EXPOSURE TO BEAM
CLASS 3B LASER PRODUCT
(IEC 60825-1, 2002)
MAX. 500 mw, 700-1680 nm

CLASS 1 LASER PRODUCT
(IEC 60825-1, 2002)

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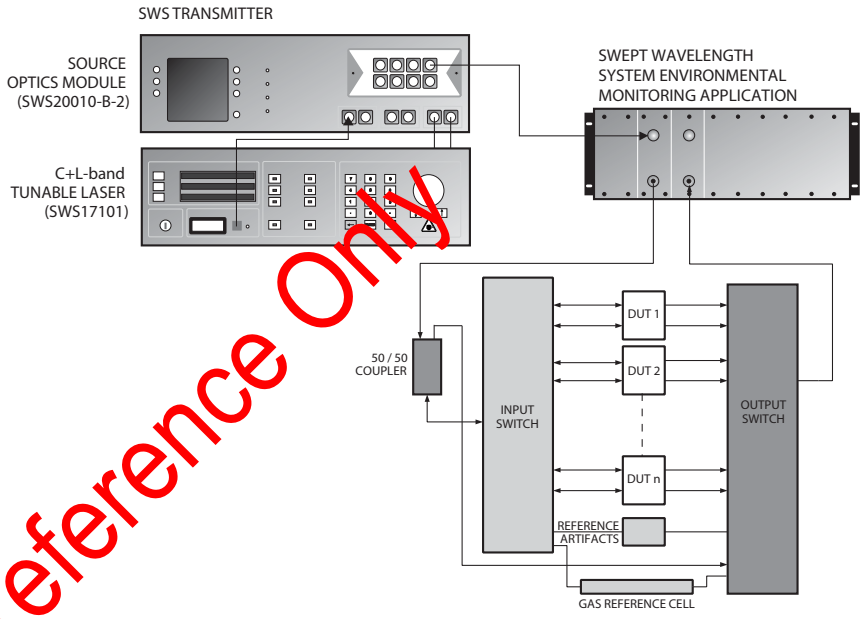

Swept Wavelength System Environmental Monitoring Application

Each Device Output Port Set-up Includes:

- Output description - name for this port, for example, Through channel, Drop, ITU 191.95
- Connection to optical switches - which switch channels is device connected to
- Type of trace, parameters to be calculated, for example, BandPass, BandStop, Etalon
- Channel set-up (Center Frequency, FSR)
- Specification list (see Specification Manager)

Continued

In the test software set up, each output for each device is given a name. Assigned to that name are the switch connections and a specification file describing the measurements required and the acceptance limits for that output. Complete flexibility is afforded with this scheme, any output of any device can have different properties, and be measured in different ways with different acceptance limits.

Typical Output View Showing Trend with Time

The Specification Manager is used to create one or more custom specification lists for the test to be undertaken. The user selects appropriate specifications from a master list, and can additionally customize any specification for the test. The DUTs tested might have the same specification or different specification, and might be used for the different outputs of different devices.

Each of the available measurement parameters (see list) can be modified to suit user needs, the name can be adapted to suit local conventions, Pass/Fail criteria can be defined, and wavelength or frequency and units can be chosen.

Available Measurement Parameters Include:

- Actual center wavelength
- Offset of center wavelength from ITU
- Bandwidth at xdB threshold
- Effective bandwidth
- IL - at actual center or on ITU
- Flatness across passband
- Ripple across passband
- Crosstalk - left, right or total
- PDL - at actual center or on ITU
- Average FSR for interleaver
- Uniformity of interleaver bands

Specifications

Swept Wavelength System - Environmental Monitoring Application (SWS-EMA) Option

System Performance	Single Output Source Optics Module
Wavelength range	1520 to 1630 nm C+L-band 1420 to 1530 nm S-band
Absolute wavelength accuracy	± 2 pm
Measurement resolution	1 pm
Maximum number of device channels	160 input, 160 output
Minimum test interval	6 minutes
Minimum test duration	1 hour
Loss measurement repeatability[1]	± 0.05 dB (0 to 25 dB device IL)
includes polarization state averaged IL	± 0.10 dB (25 to 45 dB device IL)
Loss measurement resolution	0.01 dB
RL measurement range	55 dB
Polarization dependent loss (PDL) measurement repeatability[1,2]	± 0.02 dB (0 to 20 dB device IL)
PDL measurement resolution	0.01 dB
Maximum slope resolution	10 dB/pm (0 to 30 dB device IL)
Measurement time	
IL mode	10 s per device port (any measurement)
PDL mode	40 s per device port (any measurement)
Scan speed	20 nm/s

1. System monitors changes (with respect to initial conditions) in IL and PDL during environmental challenges.
2. Using SWS15107-A PDL, optimized Detector Modules.

Ordering Information

For more information on this or other products and their availability, please contact your local JDS Uniphase account manager or JDS Uniphase directly at 1-800-498-JDSU (5378) in North America and +800-5378-JDSU worldwide or via e-mail at sales@jdsu.com.

Ordering Information for SWS-EMA

Please contact a JDS Uniphase customer service representative to order a SWS-EMA system. For practical help on setting-up an environmental test program, visit:

www.jdsu.com/instrumentation

If the configurations available do not meet your performance requirements, please contact our global sales and customer service team to discuss the potential for specialized solutions.

Swept Wavelength Systems

Devices designed for use in dense wavelength division multiplexed (DWDM) systems must be characterized as a function of wavelength. Typical characterization parameters include insertion loss (IL), polarization dependent loss (PDL) and return loss (RL). Advanced devices for higher speed, wavelength routed, or long haul systems may require measurement of the chromatic dispersion and polarization mode dispersion or differential group delay.

The JDS Uniphase Swept Wavelength Systems (SWS) are specifically designed to rapidly measure these parameters at high wavelength resolution, high dynamic range and on multiple channel devices, while limiting capital costs. The SWS supports the distributed architecture model. In this model, a single wavelength source can be distributed to eight independent test stations. This reduces the capital cost by sharing one tunable laser source between all stations. The system is available in two versions.

The SWS2000 is the basic system for component characterization. It supports insertion loss, polarization dependent loss and return loss measurements.

The SWS-OMNI is an upgrade to the SWS2000 that allows measurements of chromatic dispersion and differential group delay. The SWS-OMNI uses the industry-standard phase shift method for the chromatic dispersion measurements.

Included in This Section

Swept Wavelength System

SWS2000 Series

Key Features

- Scalable architecture - add more stations any time
- ± 0.002 nm absolute wavelength accuracy
- Up to 128 detector channels available per station
- Remote source laser can be shared by up to 8 workstations
- High speed scanning (user controllable) up to 40 nm/s
- Flexible easy-to-use software
- Customized applications through dynamic link libraries (DLLs)
- 24/7 service and support

Applications

- Optical component and module characterization in both R&D and manufacturing environments
  - ROADMs, Wavelength Switches, Wavelength Blockers
  - Circuit Packs
  - Dense wavelength division multiplexing (DWDM), Coarse wavelength division multiplexing (CWDM)
  - Tunable Filters, Couplers, Splitters, Switches, Attenuators, Fiber Bragg Gratings (FBGs), Interleavers, Dichroic Filters
  - Micro-Electro-Mechanical Systems (MEMS) and Waveguide Devices

Safety Information

Complies to CE requirements plus UL3101.1 and CAN/CSA - C22.2 No. 1010.1. The laser source in the Source Optics Module (SWS20010) is a class 1. The Tunable Laser Source (SWS17101 and SWS18101) is a class 3B laser. Both are classified per IEC standard 60825-1(2002) and comply with 21CFR1040.10 except deviations per Laser Notice No. 50, July 2001.

INVISIBLE LASER RADIATION
AVOID EXPOSURE TO BEAM
CLASS 3B LASER PRODUCT
(IEC 60825-1, 2002)
MAX. 500 mw, 700-1680 nm

CLASS 1 LASER PRODUCT
(IEC 60825-1, 2002)

The Swept Wavelength System SWS2000 series remains the industry standard solution for measuring insertion loss (IL), polarization dependent loss (PDL), return loss (RL) and directivity with high wavelength resolution in both research and development (R&D) and production environments. Currently used at more than 80 customer sites, with over 8500 detector channels deployed, the SWS test platform validates optical performance for the latest in optical components and modules including: ROADMs, Wavelength Switches, Tunable Filters and Circuit Packs. The SWS system consists of a tunable laser source, a source optics module (SOM), a control module, a receiver chassis, one or more detector modules and application software.

With a ± 0.002 nm absolute wavelength accuracy over the entire 1420 to 1630 nm range, a high sweep speed of 40 nm/s, and a deep dynamic range of > 70 dB, the SWS2000 provides excellent performance combined with a low cost of ownership; the distributed architecture supports up to eight separate, individually controlled measurement stations per source laser. Often purchased initially as an R&D tool, this scalability in the number of measurement stations provides customers the flexibility to transition the equipment from R&D to production.

Upgrade packages from legacy SWS systems to the SWS2000 platform are available to ensure that existing SWS users receive the maximum benefit from their existing capital infrastructure.

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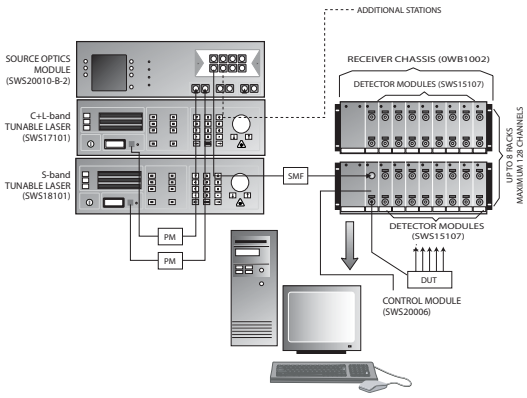

Typical Configuration of SWS2000

SWS directly measures IL, PDL and average loss as a function of wavelength. RL is measured with the optional RL modules (SWS20005). Using the raw IL and PDL data, the application software provides a comprehensive set of analysis tools that calculate:

- Loss at peak
- Center wavelength, from x dB threshold
- Loss at center wavelength
- Bandwidth at x dB threshold
- Crosstalk, left/right and cumulative
- Flatness

These parameters are calculated relative to the measured peak, ITU grid or user-defined grid.

The SWS is delivered with a set of DLLs that can be used to develop software to suit custom testing requirements. The DLLs function through the SWS receiver hardware, allowing access to all SWS functionality. Using the supplied DLLs, applications may be developed in Visual Basic™, C, C++, or LabView environments.

With a 4-state polarization controller located within the SOM, PDL and average loss are measured quickly as a function of wavelength. Four polarization states at 0°, 90°, - 45° and circular polarization are measured, and the Mueller matrix analysis is used to accurately determine PDL at all wavelengths scanned.

When the very highest accuracy PDL measurements are required, a special version of the detector module should be used. The SWS15107-A contains specially selected and tuned components to allow PDL measurement to an accuracy of better than ± 0.01 dB. This module is supplied with a fixed FC/APC connector.

All specifications listed are met simultaneously. No change in wavelength accuracy (± 2 pm) or scan speed (20 nm/s) is required to obtain a 70 dB dynamic range.

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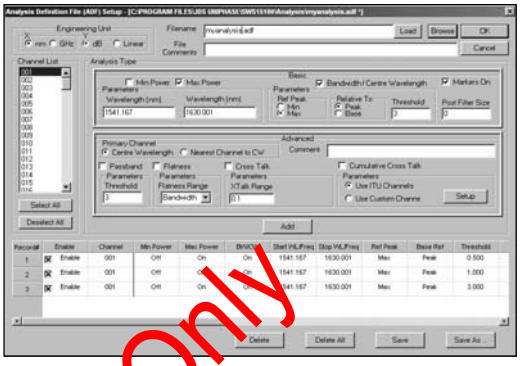
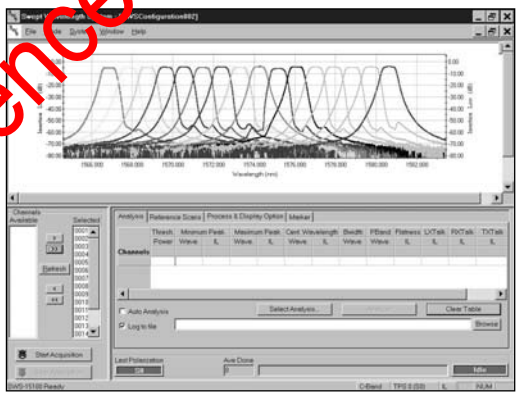
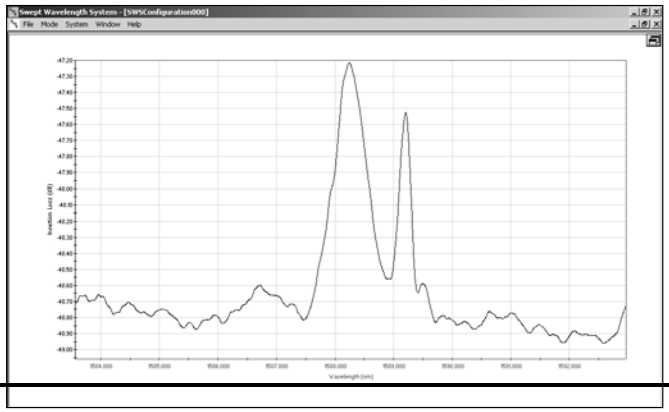


Analysis Setup Window



Data Display and Control Window



RL Measurement with SWS2000

Specifications

SWS2000 Performance	Single Output Source Optics Module
Wavelength range	1520 to 1630 nm C+L-band
	1420 to 1530 nm S-band
Absolute wavelength accuracy	± 2 pm
Measurement resolution[1]	1 pm
Wavelength sampling resolution	3 pm
Insertion loss (IL) measurement accuracy[2,3]	± 0.05 dB (0 to 25 dB device IL)
including polarization state averaged IL	± 0.10 dB (25 to 45 dB device IL)
	± 0.20 dB (45 to 65 dB device IL)
Dynamic range[3]	> 70 dB
Loss measurement repeatability[2]	± 0.02 dB
Loss measurement resolution	0.01 dB
Return loss (RL) measurement range[3,4]	60 dB
Polarization dependent loss (PDL) measurement accuracy[2]	± 0.05 dB (0 to 20 dB device IL)
using standard detector module SWS15107	± 0.10 dB (20 to 40 dB device IL)
PDL measurement accuracy[2]	± 0.01 dB (0 to 20 dB device IL)
using tuned PDL detector module SWS15107-A with 13-point smoothing and 4 averages[1]	± 0.03 dB (20 to 40 dB device IL)
PDL measurement repeatability[1]	± 0.01 dB
PDL measurement resolution[1]	0.01 dB
Maximum slope resolution	10 dB/pm (0 to 35 dB device IL)
Measurement time	9 seconds + 0.5 seconds per channel
Maximum scan speed[5,7]	40 nm/s
Fiber type (to device-under-test)	SMF-28
Maximum outputs from device under test (DUT) measured	128
Measurement stations per transmitter	Up to 8, in 1, 2, 4, or 8 steps
Detector adapters[6]	FC, SC, ST, LC, bare fiber
Input voltage	110 to 230 V AC , 50 to 60 Hz
Receiver control	Custom interface for Win95/98/2000/XP
Receiver communication with computer	National Instruments™ PCI interface card
Operating temperature	15 to 35 °C
Storage temperature	0 to 70 °C
Operating humidity	80 % RH maximum, non-condensing
Dimensions (W x H x D)	
Source optics module(SOM) (SWS20010-B-2)	48.3 x 13.3 x 37.5 cm
Tunable laser source (SWS17101/SWS18101)	48.3 x 13.3 x 43.2 cm
Receiver chassis (OWB10002)	48.3 x 13.3 x 46.0 cm
Control and detector modules	Plugged into chassis

1. Wavelength resolution defined as the minimum calculated center wavelength shift.
2. Does not include influence of connector.
3. Device IL range/dynamic range both reduced for multiple output SOM.
4. RL module SWS20005 required.
5. ~~10 and 20 nm/s also selectable.~~
6. High PDL accuracy Detector Module SWS15107-A using FC/APC only.
7. All other specifications are maintained when using a scan speed of 20 nm/s.

Ordering Information

For more information on this or other products and their availability, please contact your local JDS Uniphase account manager or JDS Uniphase directly at 1-800-498-JDSU (5378) in North America and +800-5378-JDSU worldwide or via e-mail at sales@jdsu.com.

SWS2000 Core System Part Numbers	Description
SWS17101	C+L-band Tunable Laser
SWS20010-B-2	Dual output integrated source optic module (SOM)
SWS20006-A	All-band control module: computer and PCI kit included
OWB10002	Receiver chassis
SWS15107	All-band detector module

SWS2000 Optional Equipment and Accessories Part Numbers	Description
SWS18101	S-band Tunable Laser
SWS15107-A	Polarization dependent loss (PDL) Optimized all-band detector module
SWS15107-M	All-band detector module, multimode (MM)
SWS20004	PCI Interconnect card and cable kit
SWS20005	Return loss (RL) cassette (single channel)
SWS20006-B	All-band control module: PCI kit included
SWS20013	All-band calibration kit
OWB10001-A	Dual Laser + SOM transmission cabinet
AC100	Detector cap
AC101	FC detector adapter
AC102	ST detector adapter
AC103	SC detector adapter
AC118	LC detector adapter
AC120	Magnetic detector adapter
AC121	Bare fiber holder (requires AC120)
AC320	Integrating sphere
J-FAFP-B-001	FC/APC to FC/PC jumper cable, 1 m
J-FASP-B-001	FC/APC to ST/PC jumper cable, 1 m
J-FASC-B-001	FC/APC to SC/PC jumper cable, 1 m
J-FASU-B-001	FC/APC to SC/APC jumper cable, 1 m

Swept Wavelength System

SWS-OMNI Expansion Series

Key Features

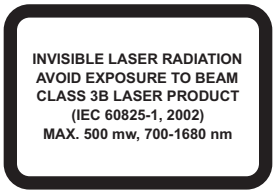
- Virtual Modulation Frequency Feature (VMFF) - flexible post-processing
- Measures IL, PDL, GD, DGD with a single bench or rackmountable receiver
- Distributed Architecture - Add additional measurement stations at any time
- Wideband scanning 1520 to 1630 nm, in one sweep
- High speed; two-channel device characterization over C-band or C+L bands for simultaneous measurement of all parameters
- Calibrated to NIST CD and Polarization Mode Dispersion (PMD) standards
- Powerful engineering software package + DLL library - custom software applications

Applications

- Passive optical component and fiber characterization in lab and manufacturing environments.

Safety Information

Complies to CE requirements plus UL3101.1 and CAN/CSA-C22.2 No. 1010.1. The laser source in the Source Optics Module is a class 1 laser. The Tunable Laser Source (SWS-17101) is a class 3B laser. Both are classified per IEC standard 60825-1 (2002) and comply with FDA standard 21CFR 1040.10 except deviations per Laser Notice No. 50, July 2001.



With the simple addition of an RF modulator within the SOM and an OMNI receiver, an existing Swept Wavelength System SWS2000 system can be used to measure group delay (GD) and differential group delay (DGD).

Existing test stations can still be used.

SWS-OMNI adds to the SWS family of test systems and provides leading-edge performance for fast all-parameter testing for efficient engineering, research and development (R&D) and production testing operations. SWS-OMNI rapidly and accurately measures insertion loss (IL), polarization dependent loss (PDL), GD and DGD characteristics of a wide range of passive optical components and optical fiber using a dual channel receiver for higher-throughput and lower-cost testing.

The modular architecture of the SWS-OMNI enables a user to add the SWS-OMNI receiver to an existing SWS transmitter to provide a stand-alone all parameter test station without the added expenditure of another tunable laser and wavelength meter. These additional test stations are purchased at a relatively low incremental cost providing best multi-station capital expenditure economics in the industry.

From phase and IL measurements, SWS-OMNI software calculates CD, PDL, GD and DGD as a function of wavelength or frequency. Displayed data may be further analyzed on-screen using markers, or setup to automatically analyze the data in the parameter ranges defined. This data can be exported for further analysis. The software also has dynamic link libraries (DLLs) that can be used to easily develop custom software in LabVIEW, Visual Basic or C+ a feature that is especially useful in a production environment.

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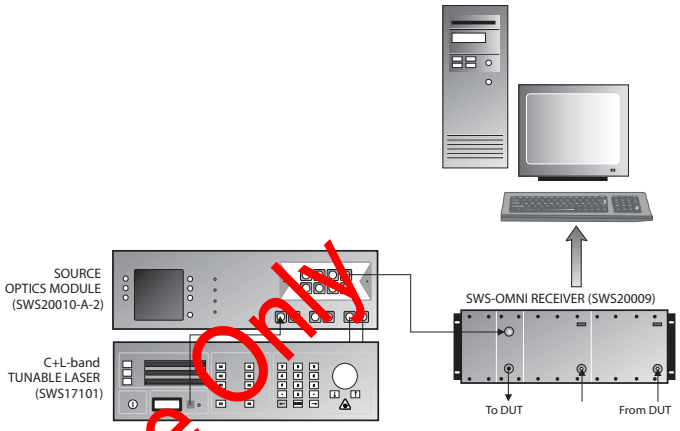
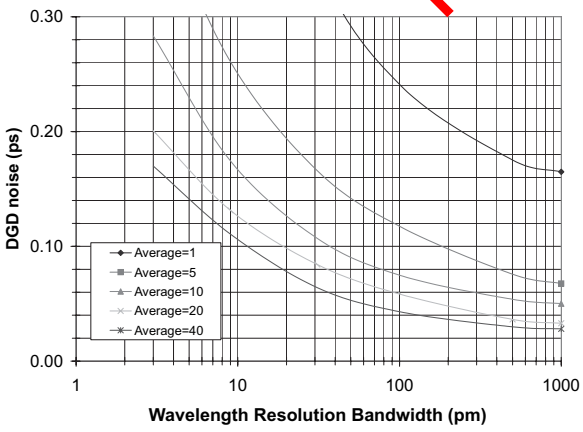


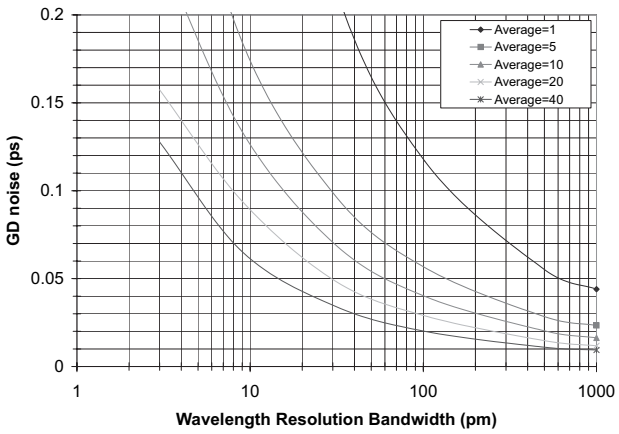
SWS-OMNI Virtual Modulation Frequency Feature (VMFF)

To improve the group delay noise and resolution, conventional modulation phase measurement techniques often employ an adjustable modulation frequency which needs to be set before measurements are made. In contrast, the SWS-OMNI system uses the proprietary VMFF. All swept group delay measurements are made at a fixed modulation frequency (192 MHz) optimized for the 3 pm wavelength sampling step of the SWS. The data is then post-processed to achieve higher effective modulation.

Performance Curves



Typical Differential Group Delay Performance Curves (3σ)

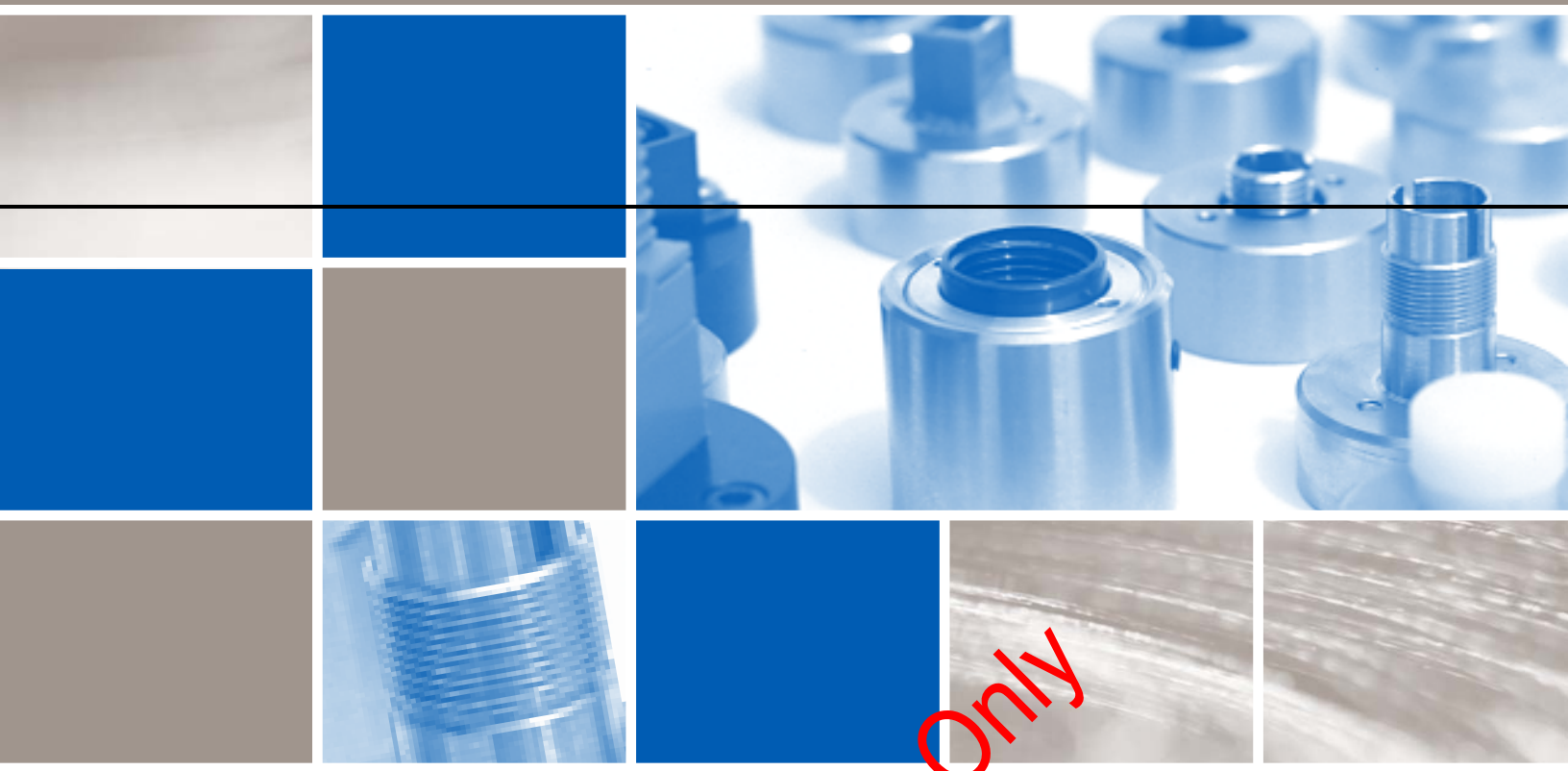


Typical Group Delay Performance Curves (3σ)

Specifications

Parameter	Specification
Wavelength	
Measurement range C+L-band	1520 to 1630 nm
Wavelength span	110 nm
Absolute accuracy	± 2 pm
Wavelength sampling resolution	3 pm
Measurement resolution[1]	1 pm
Insertion loss (IL)[2,3]	
Dynamic range	45 dB
Accuracy	
(0 to < 5 dB)	± 0.05 dB
(5 to < 25 dB)	± 0.10 dB
(25 to 45 dB)	± 0.25 dB
Resolution	0.01 dB
Group delay[2,3]	
Dynamic range	20 dB
Accuracy (at < 10 dB IL)[4]	1.5 % typical
Uncertainty[5]	See attached performance curves
Modulation frequency[6]	192 MHz or greater
Maximum slope	800 ns/nm
Polarization dependent loss (PDL)[2]	
Dynamic range	45 dB
Accuracy (0 to < 10 dB)	± 0.05 dB
Resolution	0.01 dB
Differential group delay[2]	
Dynamic range	20 dB
DGD uncertainty[5]	See performance curves below
Polarization mode dispersion (PMD) accuracy (typical)[7]	± 0.02 ps

1. Measurement resolution is defined as the smallest shift in wavelength that can be detected using the analysis function.
2. Measured using SWS-OMNI transmitter under optimal power output.
3. Polarization state averaged.
4. Maximum deviation from NIST standard reference 2524.
5. Indicated uncertainty at 99.7% confidence level (3σ).
6. Theoretically no upper limit.
7. Based on the measurement of NIST standard reference 2518 (Mode-coupled PMD artifact, wavelength range 1520.5 to 1568.5 nm, DGD ~ 329 fs).



Accessories and Support Options

Included in This Section

Measurement Accessories

DETECTOR ADAPTERS

(2 mm and 3 mm InGaAs and 5 mm Ge detectors only)

Part Number	Description
AC100	Detector cap
AC101	FC adapter
AC102	ST adapter
AC103	SC adapter
AC104	D4 adapter
AC105	Biconic or biconic SPA
AC106	DIN DF
AC107	SMA906
AC108	Diamond HMS-0
AC109	SMA905 adapter
AC112	MT (ribbon connector)
AC113	Ribbon fiber holder (requires AC120)
AC114	MU
AC115	E2000
AC116	FC, ST, SC universal adapter
AC117	MPO/MTP
AC118	LC
AC119	MT-RJ
AC120	Adapter holder (for AC121 and AC113)
AC121	Bare fiber holder (requires AC120)

(10 mm InGaAs detectors only)

Part Number	Description
AC200	Detector cap
AC201	FC adapter
AC202	MT (ribbon connector)
AC203	MPO/MTP
AC204	Ribbon cable bare fiber adapter
AC205	SC adapter
AC206	MT-RJ adapter (for10 mm)

(10 mm Ge detectors only)

Part Number	Description
AC400	Detector cap
AC401	FC/PC adapter
AC402	MPO/MTP adapter

JUMPERS

Hybrid Master Jumpers (2 meters)

Part Number	Description
M-FPFA-B-002-S1	FC/PC Master to FC/APC regular connector
M-FPSU-B-002-S1	FC/PC Master to SC/APC regular connector
M-SCFA-B-002-S1	SC/PC Master to FC/APC regular connector
M-SCSU-B-002-S1	SC/PC Master to SC/APC regular connector
M-FAFP-B-002-S1	FC/APC Master to FC/PC regular connector
M-FASC-B-002-S1	FC/APC Master to SC/PC regular connector
M-SUFP-B-002-S1	SC/APC Master to FC/PC regular connector
M-SUSC-B-002-S1	SC/APC Master to SC/PC regular connector

Calibrated Hybrid Jumper

Part Number	Fiber Type	WL Range (µm)
CH200-A2-FAFP	9/125, FAFP	1.3, 1.5
CH200-A2-SUFP	9/125, SUFP	1.3, 1.5
CH200-A3-FAFP	9/125, FAFP	1.3, 1.5, 1.6
CH200-A3-SUFP	9/125, SUFP	1.3, 1.5, 1.6
CH200-A6-FAFP	9/125, FAFP	1.4, 1.5, 1.6
CH200-A6-SUFP	9/125, SUFP	1.4, 1.5, 1.6
CH200-07-FAFP	50/125, FAFP	0.8, 1.3
CH200-07-SUFP	50/125, SUFP	0.8, 1.3
CH200-17-FAFP	62.5/125, FAFP	0.8, 1.3
CH200-17-SUFP	62.5/125, SUFP	0.8, 1.3

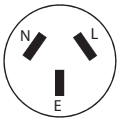
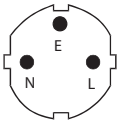
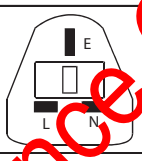
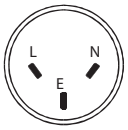
ADDITIONAL ACCESSORIES

UCAs (Universal Connector Adapters)

Part Number	Description
AC500	FC/PC to FC/PC
AC501	FC/PC to SC/PC
AC502	FC/APC to FC/APC
AC503	FC/APC to SC/APC

Integrating Spheres

Part Number	Description
AC320	20 dBm integrating sphere
AC330	33 dBm integrating sphere

DESTINATION	ILLUSTRATION	PART NUMBER
Australia, China		A0102338
Austria, Belgium, Finland, France, The Netherlands, Germany, Spain, Portugal, Sweden, Chile, Korea		A0100741
Denmark		A0102681
Hong Kong, Ireland, United Kingdom, Malaysia		A0100740
India		A0102180
Israel		A0101407
Italy[1]		A0100742
North America, Central America, Colombia, Ecuador, Japan, Taiwan, Venezuela, Thailand		A0100483
Switzerland		A0101406

1. This plug is not polarized.

For the connector table:

E Earth
L Line
N Neutral

Power Cord

JDS Uniphase provides the appropriate power cord for the destination specified on the purchase order. If another power cord is required, please specify at the time of order.

Rackmount Kit

Each rackmount kit provided with the instrument is a North American rackmount. Refer to the list if another rackmount type is needed.

Destination	Part Number
Japan	ED000899-A-01

Instrumentation Technical Support

Technical Support

JDS Uniphase has a dedicated post-sales support team ready to help you answer any questions or concerns about Instrumentation products. Please refer to the front of this catalog for technical support contact information.

Extended Support Options

In addition to our standard level of support coverage on all our products, you may wish to purchase one or more of our support services to help you meet your specific needs. Tell us what your requirements are. We will work together to find a solution.

Extended Support Options include:

- **Extended Warranty**
- **Service agreement**
- **Loaner products**
- **Technical training**
- **On-site calibration service**

Please refer to the Extended Support Details section or contact our technical support team for further information.

Extended Support Details

Extended Warranty
One, two, and three year extended warranties are available for many of our products. JDS Uniphase will warranty your product for an extended period of time past the standard 1-year warranty included with every product purchased.

Service Agreement
JDS Uniphase will customize a service agreement to meet your needs. We offer emergency product replacement, dedicated spare parts inventory as well as other options to meet your service requirements.

Loaner Products
Minimize service interruptions and downtime while products are being serviced. Request a spare/loaner unit while your original unit is being serviced by JDS Uniphase.

Equipment Purchased From a Third Party or Auctions
JDS Uniphase will verify, calibrate, or service used JDS Uniphase equipment purchased from a third party or at auction to ensure it is ready for use and operating within specifications. Registration and standard level of support for this equipment is also available.

Technical Training
JDS Uniphase offers courses that will allow you to maximize the benefits of our products with confidence and ease. Basic training courses show you the many features of our products allowing you to begin using the equipment immediately. Advanced training courses show you detailed aspects of the product allowing you to set-up, maintain and troubleshoot the product when necessary. All courses are delivered by one of our technical specialists, who work with the products daily.

On-site Service
Minimize service interruptions and downtime with on-site calibration service. This service is available for many of our products. For more information about any of the options indicated or to customize a support option, please contact us at the numbers listed in the Customer Support Contact Information section.

Technical Training Details

Instructor-led classroom training

Our instructor-led training provides the student with training material as well as hands-on practice with the equipment in a relaxed environment. During the training sessions, students will learn about the software and hardware for the product and be able to put what they learn into use immediately by practising on "live" equipment set up in the classroom. Advanced training prepares students to demonstrate following tasks:

- Setting-up the equipment
- Performing a measurement using the equipment
- Maintaining the equipment
- Troubleshooting and regular servicing the equipment

The course material provided allows the student to reference this information during the entire course, as well as, use as a quick reference guide when they are using the equipment back in their facility in the future. Class size is limited depending on product and purpose allowing more opportunity for personal attention and one-on-one interaction with each member of the class.

Training locations

We offer instructor-led training in fully equipped classrooms, at our JDS Uniphase Ottawa site or at your facility.

On-site training

Training courses delivered in the comfort and convenience of your own facility are also an option. On-site training reduces the amount of time and expense often required for off-site training. Time away from job and travel expenses are virtually eliminated. Our technical specialist will travel to your facility and provide all aspects of our Instructor-led course on-site. Limited class size will allow more opportunity for personal attention and one-on-one interaction with each member of the class. If our standard training package does not address all of your needs, we can customize our training to add topics of interest specific to your company.

Accreditation

Upon completion of the JDS Uniphase training courses, students are presented with a signed training certificate acknowledging that they have successfully completed the course.

Courses available but are not limited to the following:

- OCETS - Optical Component Environmental Test System
- SWS - Swept Wavelength System

Technical Training Course Overview

Optical Component Environmental Test System (OCETS)

Overview

This course gives you the tools, knowledge and confidence to carry out real-world operation and analysis of passive component characterization using the OCETS. With plenty of hands-on practice and discussion, this training course gives you theory in addition to introducing you to all the features of the hardware and OCETS software (provided with your OCETS). Students will also be shown and asked to demonstrate:

- How to verify proper operation of the system
- Troubleshooting techniques. (Guides and tools are also discussed)

Who Should Attend

- Individuals responsible for the implementation of test systems or equipment
- Individuals involved in the set-up, operation or maintenance of this equipment
- Individuals involved in the sale or demonstration of this equipment

Key Benefits

- Provides key information and familiarity for those involved in the purchasing, sale, application, operation, maintenance or demonstration of this equipment (sales, technical support, purchasing or application engineers)
- Provides hands-on experience and real time set-up of equipment
- Allows effective and efficient set-up to prepare OCETS for operation
- Allows practice of measurements to validate the correct system operation - new installation or re-installations
- Provides useful troubleshooting techniques and information to reduce downtime including detailed use of the provided OCETS software

Course Specifics

Class format:	Instructor-led
Group size:	Limited
Location:	JDS Uniphase facility or on-site
Prerequisite:	Basic knowledge of fiberoptics
	Basic knowledge of test and measurement
Duration:	2-3 days

Technical Training Course Overview

Swept Wavelength System (SWS)

Overview

This course gives you the tools, knowledge and confidence to tackle real-world operation and analysis of passive component characterization using the Swept Wavelength System (SWS). With plenty of hands-on practice and discussion, this training course gives you theory in addition to introducing you to all the features of the hardware and SWS software (provided with your SWS). Students will also be asked to demonstrate:

- How to verify the calibration (for wavelength and power) of the system and re-calibrate as required
- Troubleshooting techniques. (Guides and tools are also discussed)

Who Should Attend

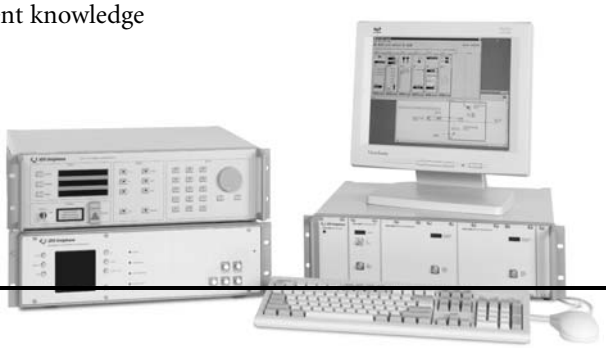
- Individuals responsible for the implementation of test systems or equipment
- Individuals involved in the set-up, operation or maintenance of this equipment
- Individuals involved in the sale or demonstration of this equipment

Key Benefits

- Provides key information and familiarity for those involved in the purchasing, sale, application, operation, maintenance or demonstration of this equipment. (sales, technical support, purchasing or application engineers)
- Provides hands-on experience and real time set-up of equipment
- Allows effective and efficient set-up to prepare SWS for operation
- Allows practice of measurements to validate the correct system operation - new installation or re-installations
- Provides useful troubleshooting techniques and information to reduce production downtime, including detailed use of the provided SWS software troubleshooting and calibration tools

Course Specifics

Course format:	Instructor-led
Group size:	Limited
Location:	JDS Uniphase facility or on-site
Prerequisite:	Basic knowledge of fiberoptics Basic test and measurement knowledge
Duration:	3 days



Product Discontinuance Cross-Reference

Discontinuances

The following products have been discontinued. For questions or comments please contact Technical Support.

Product	Last Time Buy Date	End of Service Date	Equivalent Part
OAB+3	April 15, 2005	July 1, 2006	OA-1723E2, OA-L1723S-2, BrightAmp
BBS980XX	March 1, 2003	September 1, 2004	MAP Source cassette
BLSXX	February 13, 2003	September 1, 2004	No replacement
VB	March 1, 2003	September 1, 2004	None
HA10, HA11	April 15, 2005	July 1, 2006	HA2
IA1	July 31, 2004	December 31, 2005	None
IA2	March 1, 2005	September 1, 2004	None
PR	April 15, 2004	December 30, 2005	MAP Tunable Filter (MAPF-1G)
TB2500XX	November 25, 2002	March 1, 2004	MAP Tunable Filter (MAPF-1G)
SWS15106	May 31, 2003	December 31, 2004	SWS20006-A
SWS15115	May 31, 2003	December 31, 2004	SWS20015
SWS16103	May 31, 2003	December 31, 2004	SWS20002-A-S1 (SWS All -Band SOM with Switch)
SWS15101 & SWS16101	May 31, 2003	December 31, 2004	SWS17101
SWS15102-X-XX/ SWS16102-X-XX	May 31, 2003	December 31, 2004	SWS20002-X-XX
SW1X4, 1x3, 1x5, 2x4	March 31, 2003	May 30, 2004	SQ switch
SL Switches	February 28, 2003	May 30, 2004	SQ switch
Switch/Relay Controller (DNT Series)	July 5, 2005	July 5, 2006	SB/SC switch (4-line functionality)
SW 2x2	August 1, 2005	August 1, 2006	SR 2x2

Test and Measurement Reference Guide

Included in This Section

Reference of Technical Terms

AMPLIFIED SPONTANEOUS EMISSION SOURCE	A source which exploits the spontaneous emission that occurs in an erbium-doped fiber. In general, this signal is spectrally large and unpolarized.
ANALOG	A signal on which the amplitude and frequency can vary continuously with time.
ATTENUATION	The decrease of the average optical power in an optical system resulting from various types of losses, measured in decibels.
BACKREFLECTION	Please see "return loss".
BANDWIDTH	The range of frequencies that may be handled by a device or system.
BI-DIRECTIONAL	A device that allows an optical signal to travel in either direction.
BIT ERROR RATE (BER)	The ratio of bits received in error to bits sent.
BLOCKING	The complete attenuation of an optical signal.
BROADBAND SOURCE (BBS)	A spectrally large source that emits a signal which contains a continuous range of frequencies.
CENTER WAVELENGTH	(Laser) The central operating wavelength defined by a peak mode measurement where the effective optical power resides (LED). The average of the two wavelengths measured at half amplitude points of the power spectrum.
COLLIMATING LENSES	Lenses that focus light into parallel beams.
COUPLING EFFICIENCY	The efficiency of optical power transfer between two components.
CROSSTALK	The ratio of undesired light leakage from one channel to another, expressed in dB.
DARK MEASUREMENT	A measurement of residual current from a detector, when there is no optical input.
DEGRADE	The condition in which one or more of the required performance parameters fall outside of predetermined limits, resulting in a lower quality of signal.
DETECTOR	A signal conversion device that converts power from one form to another, such as from optical power to electrical power.
DISTRIBUTED FEEDBACK LASER	An injection laser diode which has a Bragg reflection grating in the active region, in order to suppress multiple longitudinal modes and enhance a single-longitudinal mode.

Reference of Technical Terms

DRIFT	A long-term change in any attribute or value of any system or equipment operational parameter.
DYNAMIC RANGE	In a transmission system, the ratio of the overload level to the noise level of the system, usually expressed in dB. Ratio of the highest to lowest detectable signal of a system, expressed in dB.
EMULATION	The ability of a device or system to simulate the behavior of another optical device.
ERBIUM-DOPED FIBER AMPLIFIER (EDFA)	A wideband optical amplifier that uses an erbium-doped optical fiber as its active element and is characterized as having a high signal gain and high output power over a wide wavelength range.
EXCESS LOSS	The difference in dB of the sum of the inputs to the sum of the outputs.
EXTINCTION RATIO (ER)	The ratio of optical power between the principal and the minor axis of polarized light, expressed in dB.
FERRULE	A component of a connector that holds fiber in place and aids in its alignment, usually cylindrical in shape with a hole through the center.
FIBER BRAGG GRATINGS	A diffraction grating produced, in a fiber, by a variation of the refractive index that is photo-imprinted by using a pattern of ultraviolet light.
FLATNESS	Variation of insertion loss on the passband of an optical device.
GAIN	The ratio of output current, voltage, or power to input, voltage, or power respectively.
GANGED	Individual, yet mechanically linked, allowing for simultaneous movement.
HOT-SWAPPABLE	The ability of a device to withstand the removal or swapping of one or more components (such as power supplies) without interrupting the operation of the instrument.
INSERTION LOSS (IL)	Total optical power loss caused by insertion of an optical component (such as a connector, splice, coupler, etc.) into a previously continuous path.
ISOLATION	The extent to which optical power from one signal path is prevented from reaching another signal path.
LATCHING FEATURE	A switching action that requires a specific force or signal to place a switch in a position where it remains until prompted by another force or signal.
LINEARITY	The deviation of a measured change of a performance parameter from the expected change.

Reference of Technical Terms

LOSS VS WAVELENGTH	The variation in insertion loss over a specified wavelength range shown in a spectral plot.
MODULATION	The process by which the characteristic of one wave (the carrier) is modified by another wave (the signal).
MULTIMODE (MM)	Capable of handling/supporting the propagation of more than one bound mode at a given operating wavelength.
MULTIPLEXING	To use a common propagation medium, such as an optical fiber to provide for two or more channels. The process of combining two or more signals together to increase the systems total bandwidth
ORTHOGONAL POLARIZATION MODES	A polarization mode that is independent and mutually exclusive of another polarization mode.
PASSBAND	The range of frequencies where the loss of a device or system is with a range of specified limits.
PASSIVE OPTICAL COMPONENTS	A device in which operations are performed by the propagation media through which the waves pass without the use of input energy other than that contained in the waves themselves.
PIGTAIL	A length of optical fiber attached to a connector, source, detector, or coupler used to couple fiber between the device and the transmission fiber.
POLARIZATION	The orientation of the electric field in a lightwave.
POLARIZATION DEPENDENT CENTER WAVELENGTH	The dependence of the peak transmission or reflection wavelength on the state of polarization of the incident light.
POLARIZATION DEPENDENT LOSS (PDL)	The difference between the maximum and minimum values of loss due to the variation of the polarization states of light propagating through a device.
POLARIZATION MODE DISPERSION (PMD)	Dispersion of light in a single-mode fiber as a result of the different group velocities for each of the two perpendicular polarizations of light travelling in the fiber.
POLARIZATION STABILITY/ SENSITIVITY	In an optical device, the change in a performance parameter as a function of the polarization of the input light.
REPEATABILITY	Variation in a number of repeated measured quantities when measurement conditions are changed and restored. The value corresponds to half the spread between the minimum and maximum value measured.
RETURN LOSS (RL)	Optical power that is reflected back toward the source by a component (such as a fiberoptic splice, coupler, attenuator, etc.).

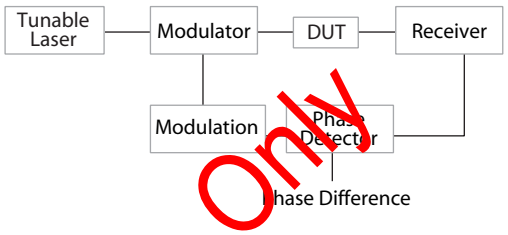
Reference of Technical Terms

RIBBON CABLES	Cables in which many fibers are embedded in a plastic material in parallel, forming a flat ribbon-like structure.
SEQUENTIAL SWITCHING	Switching between channels that is performed in single channel increments.
SINGLE-MODE (SM)	Optical fiber supporting only one spatial mode of light propagation.
SPECTRAL POWER DENSITY	In a spectral distribution, the radiative power, usually the optical power, in a specified bandwidth, spectral line, or spectral width.
SPECTRAL WIDTH	A measure of the extent of a spectrum. For a source, the width of wavelengths contained in the output at one half of the wavelength, at peak power.
SPLITTER	A passive device which divides optical power among several output fibers from a common input.
STABILITY	The extent to which a specified property, characteristic, or parameter of a substance, device, or apparatus, such as a fiber optic transmission system, remains fixed with the passage of time or with varying environmental conditions.
SWITCHING TIME	The time between the instant of initiation of the switch stimulus, to the instant of the settling of the active output of the switch.
TOGGLE	A functional unit that has two stable states and changes to the opposite state and remains there each time a command to change is given.

Chromatic Dispersion - Phase Delay Technique

Devices - Fiber, fiber Bragg gratings, Dense Wavelength Division Multiplexers (DWDMs), Erbium-Doped Fiber Amplifiers (EDFAs)

Introduction - Chromatic dispersion is the variation in transmission time as a function of wavelength. It is typically a concern for optical fibers and devices such as fiber Bragg gratings and narrow filters. It occurs because all laser sources have a finite linewidth. The absolute delay is not usually a problem but variations across the passband cause pulse spreading.



Measurement Method - The most common method involves measuring the variation in phase delay as a function of wavelength. A tunable laser is used as a source so that the details of a device structure can be obtained. The light is typically modulated using a LiNbO3 modulator. The phase difference is measured using a vector voltmeter. This approach can be used for both devices and fibers. One issue with the modulation frequency is that at 1 GHz the step size will be about 8 pm. Thus, a lower modulation frequency may be needed for some applications.

This method measures the change in delay time using the following equation, with Φ the phase measurement at the respective wavelength and fm the modulation frequency. Note it is assumed that the change in wavelength is less than a 360-degree phase shift. The dispersion is then given by the derivative of the change in time with respect to wavelength.

$$\Delta\tau = \frac{(\Phi_{\lambda 1} - \Phi_{\lambda 2})}{360 * f_m}$$

$$D = \frac{d\Delta t}{d\lambda}$$

Standards

EIA Fiber Optic Test Procedures EIA-455-169, "Chromatic Dispersion Measurement of Optical Fibers by the Phase Shift Method"

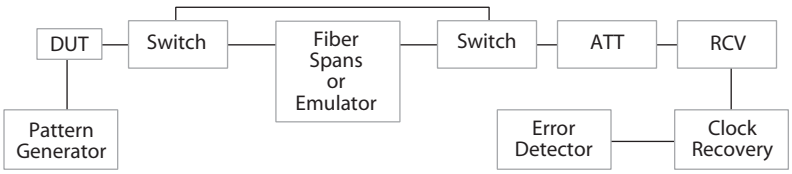
EIA-455-228, "Group Delay and Chromatic Dispersion Measurements in Single Mode Components and Devices by Phase-Shift Method"

Product References - Complete solutions are available for measuring chromatic dispersion or a set up can be built from individual parts. The complete solution is available in the Swept Wavelength System (SWS) system. The parts required for a modular approach are shown below.

Modulator	MAP Transmitter
Detector	MAP Receiver
Tunable Laser	MAP Tunable Laser
Modulation Source	external vendor
Phase Detector	external vendor (Agilent 8508 recommended)

Dispersion Penalty

Devices - 10 Gb/s ethernet transmitters, SONET transmitters, directly modulated lasers, modulators



Introduction - One limitation in optical systems is the amount of dispersion that can be tolerated. Since the dispersion comes mainly from the fiber this normally limits the overall system length.

Measurement Method - The pattern generator is set to a Pseudo-Random Binary Sequence (PRBS) pattern. The switches are set to connect the Device Under Test (DUT) directly to the receiver. The optical attenuator is set to a power level that enables error free transmission. The switches are then set to go through the fiber path. The fiber path will have a certain dispersion that depends on the wavelength. The fiber path may include optical amplifiers and attenuators. The signal power in the path has to be low enough so that there are no non-linear effects. One alternative is to use a dispersion emulator to tune the dispersion. Typical lengths of fibers may vary from 10 km to 600 km. The optical power at the receiver is set to the same power as the previous measurement. The error rate is then measured. The power is then increased until error free performance is obtained. The amount of additional power required is the dispersion penalty.

Standards

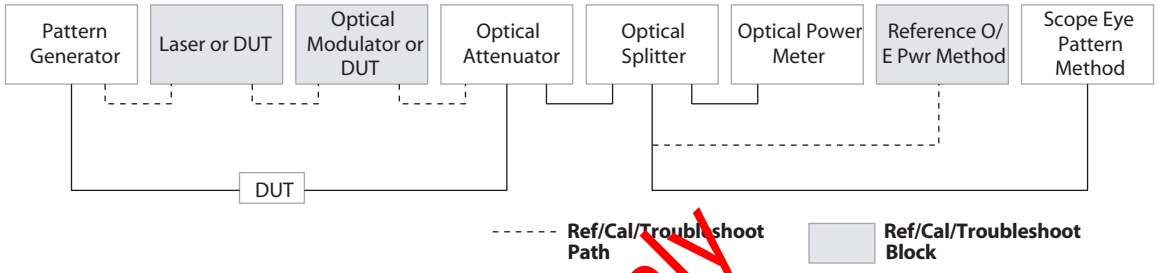
ITU G.652 Characteristics of a single-mode optical fibre cable
ITU G.653 Characteristics of a dispersion-shifted single-mode optical fibre cable
ITU G.654 Characteristics of a cut-off shifted single-mode optical fibre cable
ITU G.655 Characteristics of a non-zero dispersion shifted single-mode optical fibre cable
TIA 526-10 OFSTP-10 Measurement of Dispersion Power Penalty in Digital Single-mode-Systems

Product References - This test is usually built from a discreet set of instruments. The parts required for a modular approach are shown below.

Reference Receiver	MAP Receiver
Clock Recovery	MAP Clock Recovery
Attenuator	MAP Precision Attenuator
Optical Switch	MAP Small Channel Count or MAP Large Channel Count Switches
Fiber Spans	external vendor
Dispersion Emulator	external vendor
Pattern Generator	external vendor
Error Detector	external vendor

Extinction Ratio

Devices - Directly modulated lasers - Fabry-Perot (FP)/Distributed Feedback (DFB)/Vertical Cavity Surface Emitting Laser (VCSEL) modulators, transmitters, transponders, transceivers, Telecom/Datacom line cards



Introduction - Extinction Ratio (ER) is a measure of the average power of the optical representations of logic "1" and logic "0" typically expressed in decibels (dB). For non-return to zero (NRZ) formatted signals, the logic "1" is represented by light on, while logic "0" is represented as light off. However, there is always some finite light level for a logic "0" as driven by the need to keep the directly modulated laser partially biased-on to minimize wavelength chirp or because the external modulator can not fully suppress the input light source. The ER reported is highly dependent upon the data pattern; …101010… measurement will be different than that achieved by using a Pseudo-Random Binary Sequence (PRBS) pattern due to data pattern dependent attributes of the electro-optic technology used.

Measurement Method - ER characterizations require a Pattern Generator (PG), providing an electrical source signal operating at the desired rate and having a pattern representing the anticipated link operations, e.g. PRBS or SONET Framed. The PG drives the transmitter Device Under Test (DUT) unless a modulator component is being evaluated. In which case, a laser source is also required. The DUT output is routed to an ER measurement device where interconnect and fiber cabling losses have previously been characterized by use of a power meter. Some manufacturing configurations include a reference transmitter with known ER for calibration and diagnostic troubleshooting. The most prevalent measurement approach is an oscilloscope utilizing a calibrated O/E converter and TIA/EIA recommendation OFSTP-4 filter. This filter is the same specified for eye mask testing allowing both ER and eye mask measurements to be made simultaneously.

The ER is defined with the power measured in mW as: $ER = 10log(P_{min} / P_{max})$

Standards

TIA 526-4 OFSTP-4-A Optical Eye Pattern Measurement Procedure

Product References - This test is usually built from a discreet set of instruments. The parts required for a modular approach are shown below.

Laser Source	MAP DFB Laser	Reference Receiver	MAP Receiver
Attenuator	MAP Precision Attenuator	Optical Splitter	MAP Utility
Power Meter	MAP Power Meter	Oscilloscope with O/E	external vendor
Pattern Generator	external vendor		

Eye Mask

Product References - This test is usually built from a discreet set of instruments. The parts required for a modular approach are shown below.

Laser Source
MAP DFB Laser

Modulator
external vendor

Reference Receiver
MAP Receiver

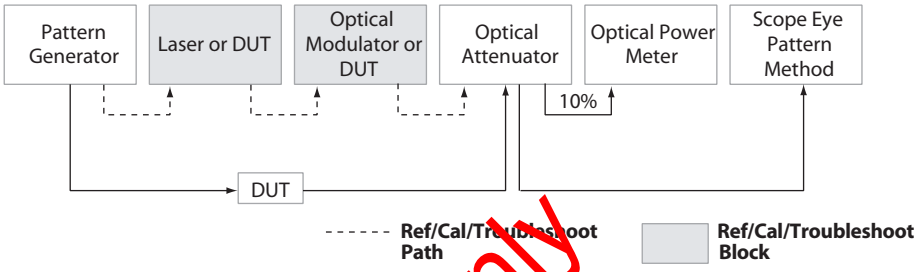
Power Meter
MAP Power Meter

Oscilloscope with O/E
external vendor

Pattern Generator
external vendor

Attenuator with Tap
MAP Precision Attenuator

Devices - Directly modulated lasers - Distributed Feedback (DFB), directly modulated lasers - VCSEL, modulators, transmitters, transponders, transceivers, Telecom/Datacom line cards



Introduction - As a quick overall quality assessment, an eye mask test aids production by defining keep-out regions instead of a series of separate eye parameter (rise time, fall time, overshoot, etc.) characterizations. The mask is typically augmented to include margin (mask regions made larger) to cover for aging and temperature degradations. Hits are defined as the number of samples taken that land in a keep-out region and is highly dependent upon the data pattern's data pattern dependent attributes of the electro-optic technology used.

Measurement Method - A pattern generator, providing an electrical source signal operating at the rate (e.g. 10GbE's 10.3125 Gb/s) and having a pattern representing the anticipated link operations (e.g., PRBS 231 -1 or SONET Framed with PRBS 27 - 1 fill), feeds the Device Under Test (DUT) unless a modulator is being evaluated (in which case a laser source is also required). The DUT output is routed to an eye mask measurement device where interconnect and fiber cabling losses have previously been characterized by use of a power meter. Some manufacturing configurations include a reference transmitter with known Eye Mask compliance as calibration and diagnostic troubleshooting. The most prevalent measurement approach is an oscilloscope utilizing a calibrated O/E converter and TIA/EIA recommendation OFSTP-4 filter. This filter is the same specified for Extinction Ratio (ER) testing allowing both eye mask and ER measurements to be made simultaneously.

Standards

TIA 526-3 OFSTP-3, "Fiber Optic Terminal Equipment Receiver Sensitivity and Maximum Receiver Input"

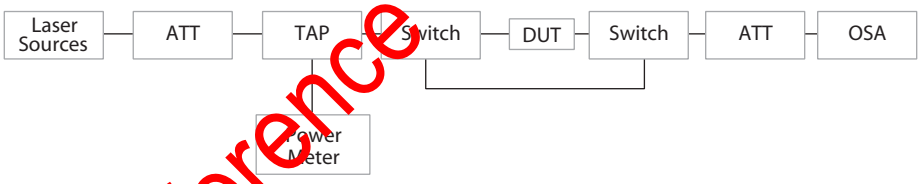
TIA 526-3 OFSTP-4-A Optical Eye Pattern Measurement Procedure.

Gain Flatness

Devices - Erbium-Doped Fiber Amplifiers (EDFAs), Semiconductor Optical Amplifiers (SOAs)

Introduction - A key parameter for optical amplifiers in Dense Wavelength Division Multiplexer (DWDM) systems is the gain flatness. The variation is best measured with the all the different channels present. In this way the effects of spectral hole burning are accurately considered. A key issue in the use of optical amplifiers is that the gain flatness will vary depending on the actual operating conditions.

Measurement Method - The test set is calibrated by measuring the ratio of the output power at the Device Under Test (DUT) and the losses through the switch paths and the loss before the Optical Spectrum Analyzer (OSA). The tap and power meter are used to set the desired input power. The measurement consists of setting the switches to measure the input spectrum and then setting them to measure the output spectrum. The ratio of these curves with the proper calibration offsets provides the gain flatness. Note that it is necessary to correct for any gain due to noise at the source. The gain flatness is the maximum variation between any two-signal wavelengths.



Standards

IEC 61290-1-1 Optical fibre amplifiers - Basic specification - Part 1-1: Test methods for gain parameters - OSA.

ITU G.661 Definition and test methods for the relevant generic parameters of optical amplifier devices and subsystems

Product References - This test is usually built from a discreet set of instruments. The parts required for a modular approach are shown below.

DFB Lasers	MAP DFB Laser
Switches	MAP Small Channel Count Switch
Attenuator	MAP Precision Attenuator
Power Meter	MAP Power Meter
OSA	external vendor
Tap	MAP Utility

Generalized Bit Error Rate Measurements

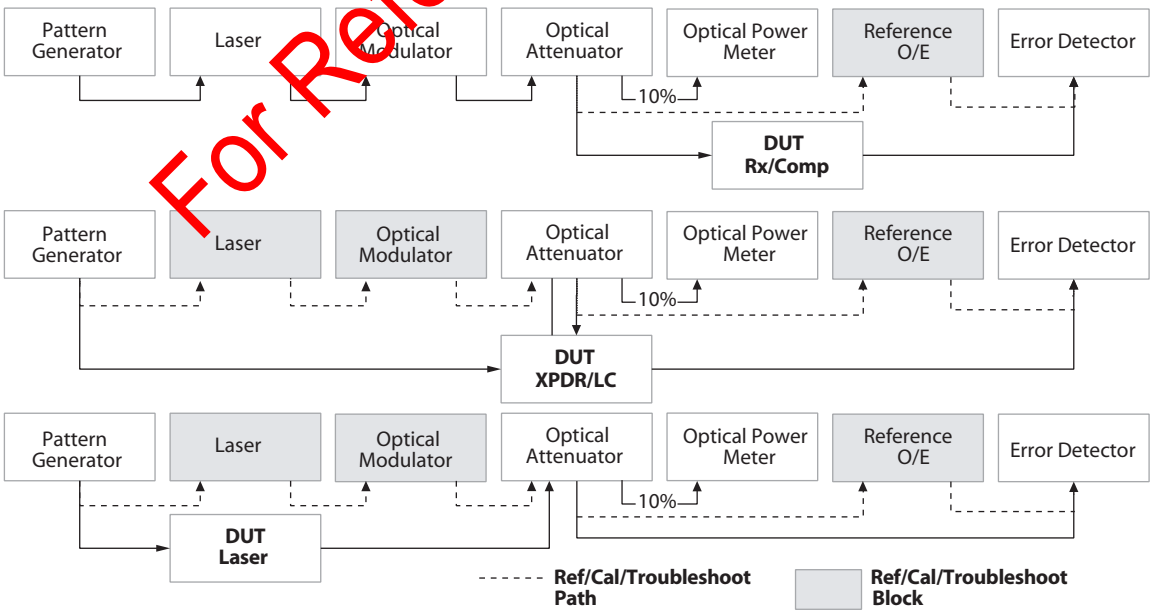
Devices - Photodiodes - PD/PIN/APD, limiter threshold slicing optimization, receivers, transmitter laser bias optimization, transponders, transceivers, and Telecom/Datacom line cards

Introduction - Sensitivity and overload are optical input dynamic range characterization tests over which a maximum acceptable Bit Error Rate (BER) is to be achieved. Standards define the receiver's BER performance under average optical power, test data pattern, and transmitter Extinction Ratio (ER) constraints. BER measurements determine these input optical power limits.

The same test configuration building blocks also support transmitter and receiver optimization. Transmitters with direct modulated lasers require proper laser biasing to improve ER as represented by improved BER. Receivers use a limiter's threshold setting to convert the O/E analog waveform back to a digital (logic "1" and logic "0") waveform. Avalanche photo diodes (APDs) in particular have higher noise under light on (logic "1") then light off (logic "0") and limiter threshold setting is optimized by way of BER characterization.

Transponders include Mux/Demux functionality while line cards include framing functionality. BER measurements within the specified dynamic range validate proper operation of these functions and flush out "stuck bits".

The level of performance under all test objectives will depend on the actual data pattern due to data pattern dependent attributes of the electro-optic technology used. At the component and transmitter/receiver level, the BER measurements exclude error correction attributes of the full system protocol.



Generalized Bit Error Rate Measurements

Measurement Method - Guidance on how to perform Bit Error Rate (BER) characterizations are provided through references in the GR-253-Core (Telecom) and IEEE 802.3 (Datacom) standards that in turn typically reference TIA/EIA materials similar to those listed below. BER measurements require a Pattern Generator (PG) and Error Detector (ED) interconnected by test and measurement building blocks along with the Device Under Test (DUT). The pattern length and sequence depend on the testing. For most measurements a 231 Pseudo-Random Binary Sequence (PRBS) is used. Other patterns may be used to test specific conditions. The optical source output is level adjusted by way of an optical power meter to account for the optical path to the DUT (or reference receiver) to establish the specified measurement level. Splitters are used to eliminate reconnections. Using the attenuator to vary the optical power level, a series of BER measurements are recorded and presented as a log linear plot of BER versus input power in dBm.

Standards

TIA 526-3 OFSTP-3, "Fiber Optic Terminal Equipment Receiver Sensitivity and Maximum Receiver Input"

Product References - This test is usually built from a discreet set of instruments. The parts required for a modular approach are shown below.

Laser Source	MAP DFB Laser
Modulator	MAP Transmitter
Reference Receiver	MAP Receiver
Attenuator with Tap	MAP Precision Attenuator
Power Meter	MAP Power Meter
Clock Recovery	MAP Clock Recovery
Error Detector	external vendor
Pattern Generator	external vendor

Insertion Loss - Fixed Wavelength

Product References - This test can be built by several components or from meters, which incorporate several of the blocks (JDS Uniphase Polarization Dependent Loss (PDL) Multimeter, Backreflection Meter, Multichannel Backreflection Meter). The parts required for a modular approach are shown below.

DFB Laser
MAP DFB Laser

Tunable Filter
MAP Tunable Filter

Polarization Controller
MAP Polarization Controller

Wavemeter
external vendor

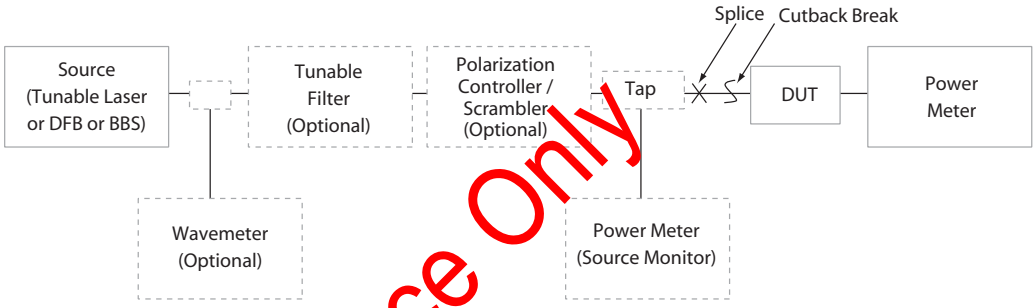
Power Meter
MAP Power Meter

Tap Coupler
MAP Utility

Tunable Laser
MAP Tunable Laser

Devices - Wavelength Division Multiplexers (WDMs), Dense Wavelength Division Multiplexers (DWDMs), isolators, circulators, switches, taps, splitters, GFF

Introduction - Insertion Loss (IL) is the most fundamental of all the measurements required for passive fiberoptic components. It relates the coupled input power to the output power through the device under test. It will vary as a function of wavelength and state of input polarization, and should be quoted with knowledge of both of these parameters. Like most measurements, the complexity will vary depending on the accuracy required.



Measurement Method - In general, the simplest implementation requires only an optical source and broadband power meter. By adding the above optional blocks, the measurement can be made more accurate and with more accurately stated input conditions. The measurement is a two-step process. In the first step the Device Under Test (DUT) is spliced into place as shown above. The power is measured on the both the power meter and the source monitor. The second step requires the device be cut from the input fiber and measured directly. It is important to ensure that the original splice is included in the measurement so that its loss may be recorded. If connectors are used then their connection uncertainty must be included in the reported accuracy.

$$IL = (P[dBm] - P_{SourceMonitor}[dBm])_{DUT} - (P[dBm] - P_{SourceMonitor}[dBm])_{CutBack}$$

The use of a tunable filter will remove background ASE noise from the source and is necessary for measurement of devices such as channel drops or rejection filters. The polarization controller or scrambler can be used to depolarize or control the source of polarization (SOP). For scrambling it is important to make sure that that the averaging time of the power meter is set much greater than the time it takes for the scrambler to cover all SOP. It is important to remember that the measurement represents an average over the bandwidth of the optical source.

Standards

TIA/EIA 455-180-A Measurement of Optical Transfer Coefficients of a Passive Branching Device (Coupler)

IEC 61300-3-4: Fibre optic interconnecting devices and passive components -Basic test and measurement procedures - Part 3-4: Examinations and measurements - Attenuation

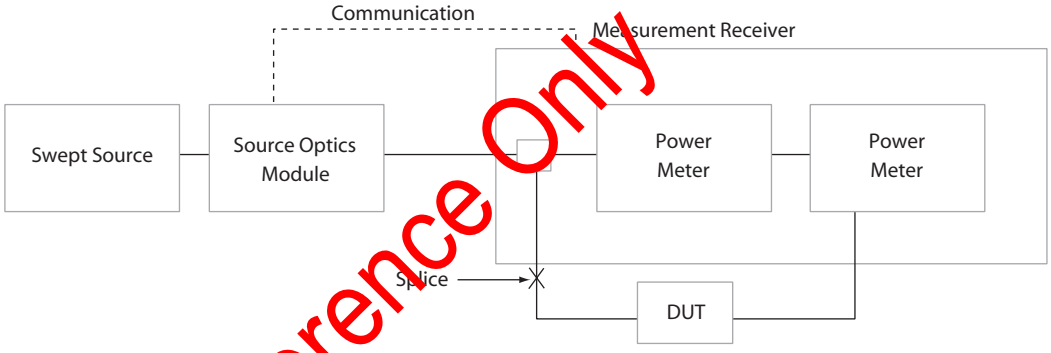
Insertion Loss - Swept Wavelength

Product References - The SWS is the ideal system to execute this test method.

SWS Tunable Laser
SWS Source Optics Module
SWS Receiver

Devices - Wavelength Division Multiplexing (WDM), Dense Wavelength Division Multiplexing (DWDM), isolators, circulators, switches, taps, splitters, GFF

Introduction - Swept wavelength measurements are very similar to the basic fixed wavelength Insertion Loss (IL) measurement from a procedural perspective. The fundamental difference is its ability to measure the loss as a function of wavelength, rapidly and accurately, through the use of a sweeping laser source and unique real time measurement technique. This makes it the method of choice for DWDM components where parameters such as bandwidth and center wavelength are required (parameters extracted from the basic IL (l) data). The reader is referenced to the fixed wavelength method as general introduction.



Measurement Method - The swept wavelength measurement technique, as embodied in the Swept Wavelength System (SWS), uses a continuous sweep of a tunable laser to generate the optical source. The Source Optics Module provides system co-ordination and real time measurement of the optical wavelength. This wavelength information is communicated through a communication channel that can be embedded optically on the same fiber as the source laser or through electrical means. In the SWS the measurement receiver is similar to the configuration to the two power meters used in the fixed wavelength method, however they are built into a single measurement unit and can be easily expanded. As in the fixed wavelength technique, a two-step process is necessary and the fundamental loss calculation remains the same.

$$IL = (P[dBm] - P_{SourceMonitor}[dBm])_{DUT} - (P[dBm] - P_{SourceMonitor}[dBm])_{Reference}$$

However, due to the fact that the laser is changing wavelength in time, it is key that the bandwidth of the power meter be properly matched to the sweep speed to ensure there is no wavelength skew in the measurement. In addition, synchronous triggering of the power meters is critical to ensure the timing to the measurements remains correlated.

Standards

TIA/EIA 455-180-A Measurement of Optical Transfer Coefficients of a Passive Branching Device (Coupler)

IEC 61300-3-5: Fibre optic interconnecting devices and passive components - Basic test and measurement procedures - Part 3-5: Examinations and measurements - Wavelength dependence of attenuation

IEC 61300-3-29: Basic test and measurement procedures - Part 3-29: Examinations and measurements - Measurement technique for characterizing the amplitude of the spectral transfer function of DWDM components

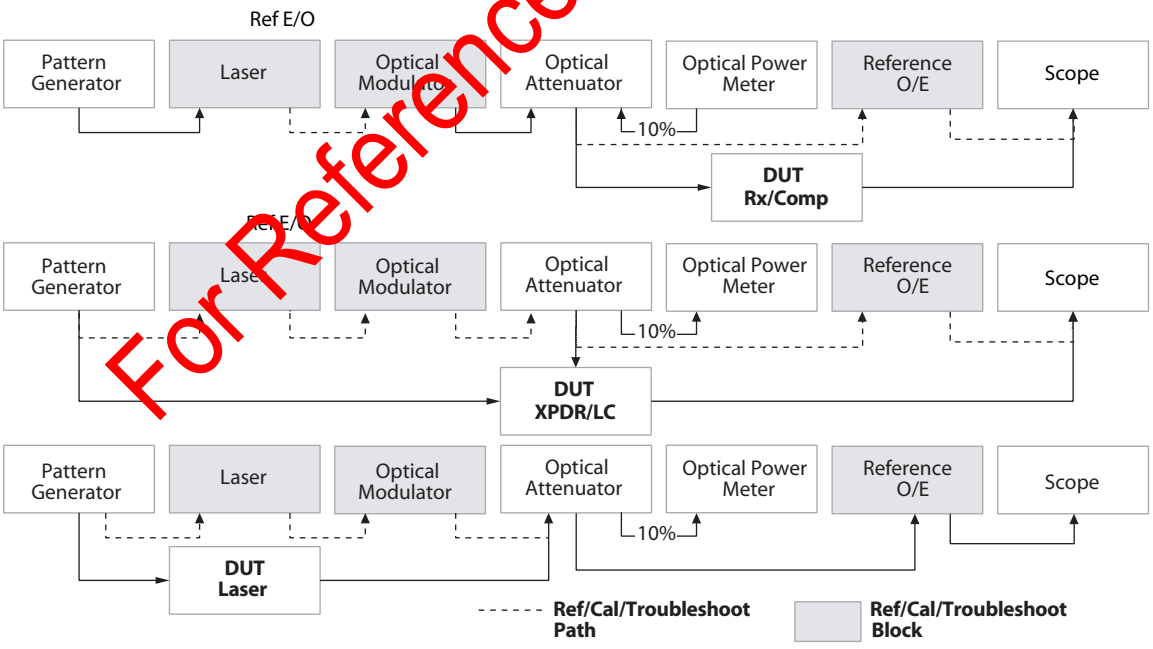
Intrinsic Jitter

Devices - Lasers, modulators, PD/PIN/APD, limiters, transmitters, receivers

Introduction - Jitter definitions include jitter tolerance, jitter transfer, and jitter generation. Both jitter tolerance and jitter transfer are functions of the clock recovery circuits in the transponder/line cards. Transmitter (module/components), fiber path, and receiver (module/components) contribute to intrinsic jitter.

Jitter can be visualized as the variation in eye crossing time and the distribution of eye crossings can be characterized as either root-mean-square (RMS) or peak-to-peak (p-p). These two characterizations are expressed in units of time (e.g., picoseconds or Unit Interval (UI) where 1 UI equals the bit duration).

The most prominent source of intrinsic jitter under system operation is pulse spreading by way of laser spectral width and chromatic dispersion. This is handled by dispersion power penalty allocations in the standards. Intrinsic jitter contributions of the E/O and O/E functions are highly dependent upon the data pattern and are known as data pattern dependent jitter.



Measurement Method - Jitter characterizations require specialized test and measurement equipment. Less accurate techniques use the eye crossing histogram data recorded by an oscilloscope. Equipment with phase controlled pattern generators use a combination of signal processing techniques and narrowband resonator/phase detectors to record the phase error generated by the recovered data clock beat against the source pattern generator clock. Low intrinsic E/O and O/E instrumentation modules are used in the characterization of transmitters, receivers and transponders.

Intrinsic Jitter

Standards

TIA 526-15 OFSTP-15, "Jitter Tolerance Measurement"

TIA 526-16 OFSTP-16, "Jitter Transfer Function Measurement"

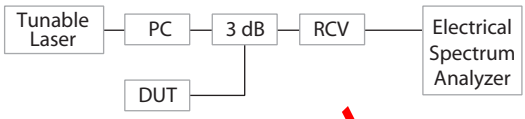
Product References - This test is usually built from a discreet set of instruments. The parts required for a modular approach are shown below.

Laser Source	MAP DFB Laser
Modulator	MAP Transmitter
Attenuator with Tap	MAP Precision Attenuator
Power Meter	MAP Power Meter
Oscilloscope with O/E	external vendor
Reference Receiver	MAP Receiver
Clock Recovery	MAP Clock Recovery
Pattern Generator	external vendor

Linewidth

Devices - Lasers

Introduction - In transmission systems the laser linewidth sets the lower limit on the penalties due to dispersion. The linewidth of the laser is measured during Continuous Wave (CW) operation. Since the linewidth of a typical Distributed Feedback (DFB) laser is less than 100 MHz an Optical Spectrum Analyzer (OSA) does not provide sufficient resolution.



Measurement Method - The measurement consists of setting the tunable laser wavelength to obtain the desired beat tone on the electrical spectrum analyzer ESA. The polarization of the laser is adjusted to maximize the beat tone. The linewidth is then obtained by measuring the FWHM of the beat signal.

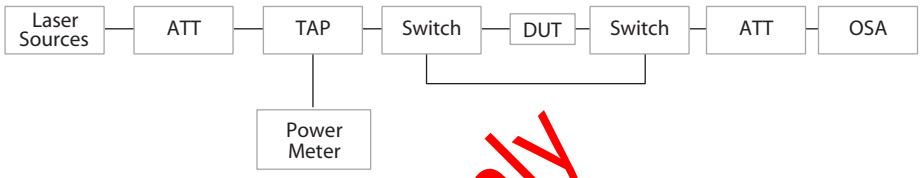
Product References - This test is usually built up from a discreet set of instruments. The electrical spectrum analyzer can be obtained with software for this measurement. Recently some vendors have developed a complete heterodyne measurement solution. The parts required for a modular approach are shown below.

Tunable Laser	MAP Tunable Laser
Polarization Controller	MAP Polarization Controller
3 dB Coupler	MAP Utility
ESA	external vendor
Receiver	MAP Receiver

Noise Figure, Source Subtraction and Interpolation

Devices - Erbium-Doped Fiber Amplifiers (EDFAs), Semiconductor Optical Amplifiers (SOAs)

Introduction - One of the problems with optical amplification is that noise is generated during the amplification process. The noise figure is the ratio of the input signal to noise ratio to the output signal to noise ratio. A key issue is that noise should be measured at the same wavelength as the signal. Also, any source noise must be removed from the measurement.



Measurement Method - The test set is calibrated by measuring the ratio of the output power at the Device Under Test (DUT) and the losses through the switch paths and the loss before the Optical Spectrum Analyzer (OSA). The tap and power meter are used to set the desired input power. The measurement begins by setting the input power to the desired value using the tap and power meter. The source spectrum is then measured on the OSA. The switches are then set and the output spectrum is measured. The gain (G) is calculated as the ratio of the output power to the input power. The ASE power (P_{ase}) is then determined by interpolating the noise levels on either side of the signal. This value must be corrected for the source noise, (P_{SN}).

Here h is Plank's constant, n is the optical frequency, and B_o is the optical bandwidth.

$$NF(dB) = \frac{10 * log\ (P_{ase} - G * P_{SN})}{GhvB_o} + \frac{1}{G}$$

Standards

IEC 61290-3 Optical fiber amplifiers - Basic specification - Part 3: Test methods for noise figure parameter

ITU G.661 Definition and test methods for the relevant generic parameters of optical amplifier devices and subsystems

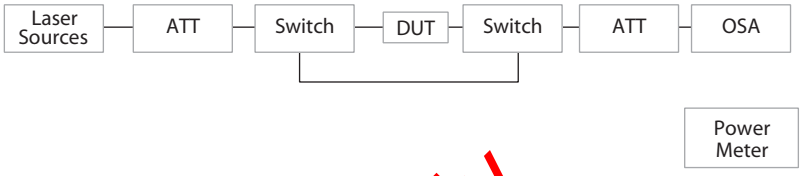
Product References - This test is usually built from a discreet set of instruments. The parts required for a modular approach are shown below.

DFB Lasers	MAP DFB Laser
Switches	MAP Small Channel Count Switch
Attenuator	MAP Precision Attenuator
Power Meter	MAP Power Meter
OSA	external vendor
Tap	MAP Utility

Optical Gain

Devices - Erbium-Doped Fiber Amplifiers (EDFAs), Semiconductor Optical Amplifiers (SOAs)

Introduction - A key parameter in the measurement of an optical amplifier is the signal gain. This is the ratio of usable input power to usable output power. One of the issues in optical amplifiers is that the amplification process produces noise in addition to the desired signal.



Measurement Method - The lasers sources can be either a Distributed Feedback (DFB) or external cavity laser for single channel operation or a set of DFB lasers if multiple channels are to be measured. The measurement begins by measuring the power into the Device Under Test (DUT) using the power meter. The attenuator (ATT) settings can then be calibrated for a range of optical powers. The output attenuator loss is also measured at this point. This attenuator is used to keep the power at the input of the Optical Spectrum Analyzer (OSA) in its linear range.

The device input is connected to the output attenuator and the trace is recorded on the OSA. The DUT is then inserted and the output trace is recorded on the OSA. The output power and noise levels are measured and the gain is calculated. The optical switch is used when multiple measurements are needed of one device.

$$Gain = \frac{P_{Out} - P_{ASE}}{P_{in}}$$

Standards

IEC 61290-1-1 Optical fibre amplifiers - Basic specification - Part 1-1: Test methods for gain parameters - Optical spectrum analyzer.

ITU G.661 Definition and test methods for the relevant generic parameters of optical amplifier devices and subsystems

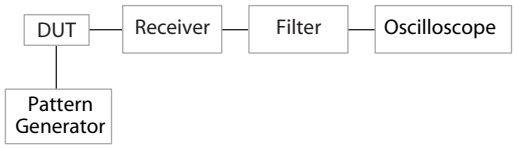
Product References - This test is usually built from a discreet set of instruments. The parts required for a modular approach are shown below.

DFB Laser	MAP DFB Laser
Tunable Laser	MAP Tunable Laser
Attenuator	MAP Precision Attenuator
Power Meter	MAP Power Meter
OSA	external vendor
Switches	MAP Small Channel Count or MAP Large Channel Count Switches

Optical Modulation Amplitude

Devices - 10 Gb/s ethernet transmitters

Introduction - One measure of an optical transmitter is the how open the modulated eye is. For the 10 Gb/s ethernet standard, this quantity is called the optical modulation amplitude. It is the absolute difference between the optical power in a logic one and a logic zero.



Measurement Method - The pattern generator is set to a square wave consisting of 4 to 11 consecutive bits. The optical output is sent to the calibrated receiver. The optional filter is a fourth order Bessel-Thompson as defined in ITU G.691. The oscilloscope display should be calibrated to measure absolute power. The measurement is the absolute difference in power measured in milliwatts. The measurement is made at the center of the eye pattern.

Standards

IEEE P802.3ae, "Media Access Control (MAC) Parameters, Physical Layer, and Management Parameters for 10 Gb/s Operation"

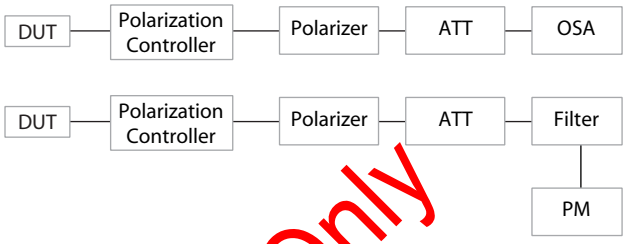
Product References - This test is usually built from a discreet set of instruments. The parts required for a modular approach are shown below.

Reference Receiver	MAP Receiver
Pattern Generator	external vendor
Electrical Filter	external vendor
Oscilloscope	external vendor

Optical Signal to Noise Ratio

Devices - Erbium-Doped Fiber Amplifiers (EDFAs), Semiconductor Optical Amplifiers (SOAs), transmitters, systems

Introduction - One measure of the performance of an optical device is the optical signal to noise ratio. This is the ratio of usable signal to noise and should be measured at the wavelength of interest.



Sometimes it may be necessary to integrate the power over an entire channel width.

Measurement Method - The measurement of Optical Signal to Noise Ratio (OSNR) is usually performed with an Optical Spectrum Analyzer (OSA). The modification shown here can be used if the signal is polarized and the noise is not. The polarization controller is first set to pass the signal light through the polarizer. Then the polarizer is rotated 90 degrees to block the signal. Now only the noise is transmitted. If the noise is unpolarized, then it is attenuated 3 dB in both measurements. The OSNR is then calculated from the two power readings. The attenuator may be needed to keep the power levels into the OSA in the linear regime. An alternative method would be to use a tunable filter and a power meter in place of the OSA.

Product References - This test is usually built from a discreet set of instruments. The parts required for a modular approach are shown below.

OSA	external vendor
Polarization Controller	MAP Polarization Controller
Polarizer	MAP Polarization Controller
Attenuator	MAP Precision Attenuator
Tunable Filter	MAP Tunable Filter
Power Meter	MAP Power Meter

Optical Time Domain Reflectometer

Devices - Optical fiber spans

Introduction - Optical time domain reflectometers (OTDRs) are used to measure the loss in optical fiber spans. They are useful for finding bad splices and connectors. This device is typically used in long fiber spans as it has limited resolution.

Measurement Method - The OTDR works by sending a short, high power pulse into the fiber. As the pulse propagates along the fiber some of the light is scattered back towards the source. This light is detected and plotted. The slope of the plot gives the fiber loss while any discontinuities indicate losses due to connectors.

Standards

Telcordia GR-196 Generic Requirements for Optical Time Domain Reflectometer (OTDR) Type Equipment

TIA 455-FOTP 8 Measurement of Splice or Connector Loss and Reflectance Using an OTDR

TIA 455 FOTP 61 Measurement of Fiber or Cable Attenuation

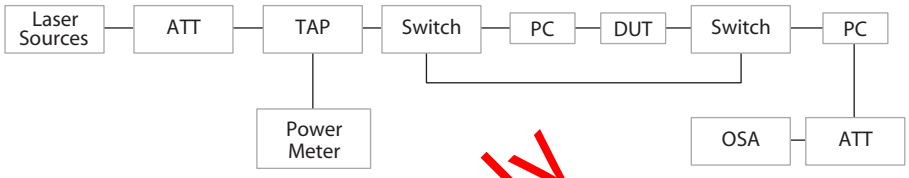
Product References - OTDRs are usually purchased as a complete unit.

OTDR	external vendor

Polarization Dependent Gain

Devices - Erbium-Doped Fiber Amplifiers (EDFAs), Semiconductor Optical Amplifiers (SOAs)

Introduction - The polarization dependence of the gain comes from either the passive components in the EDFA or from the waveguide in an SOA. The measurements are made at typical operating conditions to include the effect of gain saturation.



Measurement Method - The test set is calibrated by measuring the ratio of the power at the Device Under Test (DUT) and the losses through the switch paths and the loss before the Optical Spectrum Analyzer (OSA). The tap and power meter are used to set the desired input power. The measurement begins by setting the input power to the desired value using the tap and power meter. The source spectrum is then measured on the OSA. The switches are then set and the output spectrum is measured. The polarization controller (PC) rotates the input polarization state. At the output the polarization is also rotated to remove any Polarization Dependent Loss (PDL) of the attenuator (ATT) and OSA. This polarization controller is typically run at a higher frequency than the input polarization controller. The variation in output power is measured for each channel. The maximum value is reported.

Standards

IEC 61291-4 Performance specification template on optical amplifiers - Part 4: Optical fibre amplifiers for multichannel applications

ITU G.661 Definition and test methods for the relevant generic parameters of optical amplifier devices and subsystems

Product References - This test is usually built from a discreet set of instruments. The parts required for a modular approach are shown below.

DFB Lasers	MAP DFB Laser
Switches	MAP Small Channel Count Switch
Attenuator	MAP Precision Attenuator
Power Meter	MAP Power Meter
OSA	external vendor
Tap	MAP Utility
Polarization Controller	MAP Polarization Controller

Polarization Dependent Loss - Fixed Wavelength

Product References - This test can be built with several components or by using a meter, which incorporates several of the blocks, such as the JDS Uniphase PDL Multimeter (PS3 Series). The parts required for a modular approach are shown below.

Tunable Laser
MAP Tunable Laser

DFB Laser
MAP DFB Laser

Tunable Filter
MAP Tunable Filter

Polarization Controller
MAP Polarization Controller

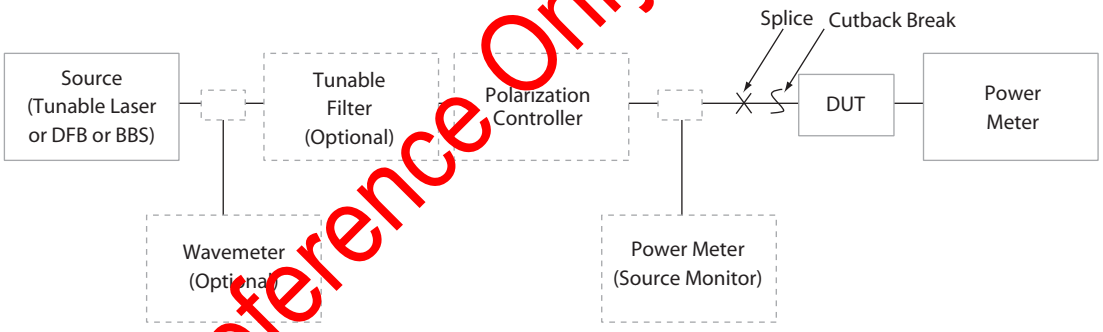
Wavemeter
external vendor

Power Meter
MAP Power Meter

Tap Coupler
MAP Utility

Devices - WDMs, Dense Wavelength Division Multiplexers (DWDMs), isolators, circulators, switches, taps, splitters, GFF

Introduction - While Insertion Loss (IL) is one of the most fundamental measurements required for passive fiberoptic components, the polarization dependence of the loss is clearly important. Polarization Dependent Loss (PDL) is defined as the maximum difference in loss measured over all states of polarization. While the PDL is typically small compared to the IL (on the order of 0.005 to 0.5 dB) the impact on fiberoptic systems can be great due to the drift in the state of polarization in single-mode fiber and the concatenation of many devices. These two effects can causes the PDL to randomly add or subtract and can cause a significant change in the receive power. It will vary as a function of wavelength just as IL, and should be quoted with the measurement conditions specified.



Measurement Method - The simplest implementation requires an optical source, polarization controller and broadband power meter. By adding the above optional blocks, the measurement can be made more accurately and with more accurately stated input conditions. There are two generally accepted methods for making the measurement, All-State-Scanning or the Mueller 4-State Method. For the All-State method, a complete (or as close as time permits) sampling of input states of polarization is made, and the minimum and maximum losses are recorded. The difference is the PDL. The Mueller method requires making 4 loss measurements at the 4 orthogonal states of polarization (0,+ 90,- 90 and Right Hand Circular) and using the equations.

$$m_{00} = \frac{T_{0(0°)} + T_{0(90°)}}{2} \qquad m_{01} = \frac{T_{0(0°)} - T_{0(90°)}}{2}$$

$$m_{02} = T_{0(45°)} - \left[\frac{T_{0(0°)} + T_{0(90°)}}{2}\right] \qquad m_{03} = \frac{T_{0(0°)} + T_{0(90°)}}{2} - T_{0(LHC°)}$$

$$PDL = -10 \times Log\left[\frac{T_{0\,min}}{T_{0\,max}}\right] = -10 \times Log\left[\frac{m_{00} - \sqrt{m_{01}^2 + m_{02}^2 + m_{03}^2}}{m_{00} + \sqrt{m_{01}^2 + m_{02}^2 + m_{03}^2}}\right]$$

Standards

IEC 61300-3-02 (All-States Method)

IEC 61300-3-12 (Mueller Method)

Polarization Dependent Loss - Swept Wavelength

Product References - The SWS is the ideal system to execute this test method.

SWS Tunable Laser

SWS Source Optics Module

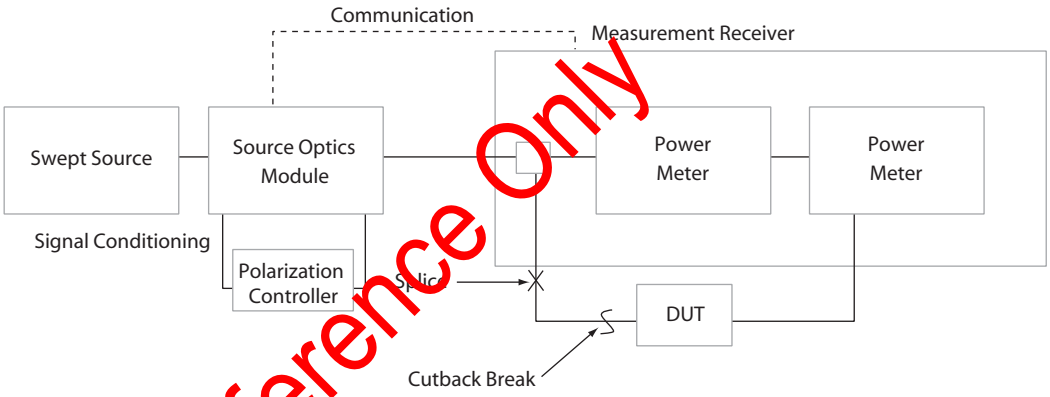
SWS20002-A-N1

SWS Receiver

SWS Polarization Controller

Devices - WDMs, Dense Wavelength Division Multiplexers (DWDMs), isolators, circulators, switches, taps, splitters, GFF

Introduction - Swept wavelength measurements are very similar to the basic fixed wavelength Insertion Loss (IL) and Polarization Dependent Loss (PDL) measurement from a procedural perspective. The fundamental difference is its ability to measure the PDL as a function of wavelength, rapidly and accurately, through the use of a sweeping laser source and unique real-time measurement technique. The reader is referenced to the fixed wavelength PDL method as general introduction. Due to the sweeping nature of the measurement, only the 4-state method is practical for PDL.



Measurement Method - The swept wavelength measurement technique, as embodied in the Swept Wavelength System (SWS), uses a continuous sweep of a tunable laser to generate the optical source. The source optic module provides system co-ordination and real time measurement of the optical wavelength. A polarization controller in the signal condition path is used to generate the 4-orthogonal states for polarization across 4 serial scans. This wavelength information is communicated through a communication channel that can be embedded optically on the same fiber as the source laser or through electrical means. In the SWS, the measurement receiver is similar to the configuration to the two power meters used in the fixed wavelength method, however they are built into a single measurement unit and can be easily expanded. As in the fixed wavelength technique, a two-step process is necessary and the fundamental loss calculation remains the same. To calculate the PDL, the equations are used with exception that the variables are arrays of data (as a function of wavelength).

$$m_{00} = \frac{T_{0(0°)} + T_{0(90°)}}{2} \qquad m_{01} = \frac{T_{0(0°)} - T_{0(90°)}}{2}$$

$$m_{02} = T_{0(45°)} - \left[\frac{T_{0(0°)} + T_{0(90°)}}{2}\right] \qquad m_{03} = \frac{T_{0(0°)} + T_{0(90°)}}{2} - T_{0(LHC°)}$$

$$PDL = -10 \times Log\left[\frac{T_{0\,min}}{T_{0\,max}}\right] = -10 \times Log\left[\frac{m_{00} - \sqrt{m_{01}^2 + m_{02}^2 + m_{03}^2}}{m_{00} + \sqrt{m_{01}^2 + m_{02}^2 + m_{03}^2}}\right]$$

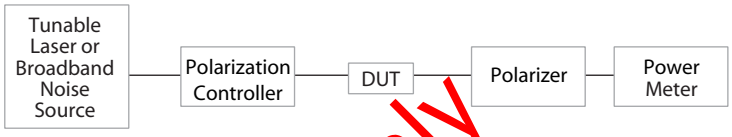
Standards

IEC 61300-3-29

Polarization Extinction Ratio - Cross Polarizer Method

Devices - Polarization maintaining components and jumpers

Introduction - Polarization maintaining devices control the evolution of the polarization state in a device. Through the use of Power Meter (PM) fiber, the polarization orientation of the light is well defined with respect to the access of the fiber. Problems can occur when the light is not well aligned with the polarization maintaining access of the fiber. For example, in polarization combiners light in the wrong polarization state is not combined but is lost.



Measurement Method - The source light, either a tunable laser source or a broadband noise source, is connected to a polarization controller that includes a polarizer. The output is aligned with the desired axis of the fiber. At the output side the polarizer is rotated and the amount of transmitted light is measured. Since the polarization maintaining fiber output should be linear there should be one position of the polarizer that passes the light. The minimum output should be with the polarizer rotated 90 degrees.

The polarization Extinction Ratio (ER), with the power measured in mW, is defined as:

$$PER = 10 log(P_{min} / P_{max})$$

Standards

EIA Fiber Optic Test Procedures EIA-455-193, "Polarization crosstalk method for Polarization Maintaining Optical Fiber and Components

EC 61300-3-40: Fibre optic interconnecting devices and passive components -Basic test and measurement procedures - Part 3-40: Examinations and measurements - ER of a polarization maintaining (pm) fibre pigtailed connector

Product References - The parts required for a modular approach are shown below.

Polarization Controller	MAP Polarization Controller
Polarizer	MAP Polarization Controller
Power Meter	MAP Power Meter
Broadband Source	MAP Broadband Source
Tunable Laser	MAP Tunable Laser

Polarization Mode Dispersion - Fixed Analyzer Method

Devices - Fiber isolators, circulators

Introduction - Polarization Mode Dispersion (PMD) is the variation in delay with polarization state. This leads to pulse broadening. For systems such as OC-192 and OC-768, PMD results in eye closure. The main source of PMD is the transmission fiber. The best fibers have PMD of 0.08 ps/km½ while older fibers may have 1 ps/km½ or more. Other sources of PMD include the isolators and erbium-doped fiber used in amplifiers.

Measurement Method - The wavelength scanning method is the simplest PMD measurement method. The tunable laser is a well-polarized source with typically better than 30 dB of Extinction Ratio (ER). As the laser is scanned the PMD will cause the polarization state at the output of the Device Under Test (DUT) to change. The polarizer at the output converts the polarization rotation into amplitude changes. The number of peaks and valleys in the amplitude plot determines the PMD. The polarization controller at the input is used to increase the amplitude of the peaks and valleys. Another option for this measurement is to use a broadband noise source and an optical spectrum analyzer.

This method is limited to devices with broad transmission characteristics. The average PMD is given by: where k is a mode-coupling factor and Ne is the number of extremes. The mode-coupling factor is 1 for devices with no coupling, such as an isolator, and 0.824 for long lengths of fibers.

$$\Delta t = \frac{kN_e \ \lambda_{start}\ \lambda_{stop}}{2(\lambda_{start}-\lambda_{stop})c}$$

Standards

EIA Fiber Optic Test Procedures EIA-455-113, "PMD measurement for single-mode optical fibers by the fixed analyzer method"

IEC 61300-3-32: Basic test and measurement procedures - Part 3-32: Examinations and measurements - Polarisation mode dispersion for passive optical components

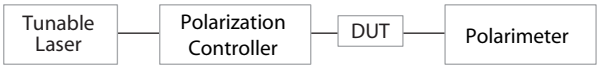
Product References - The parts required for a modular approach are shown below.

Polarization Controller	MAP Polarization Controller
Polarizer	MAP Polarization Controller
Power Meter	MAP Power Meter
Broadband Noise Source	MAP Broadband Source
OSA	external vendor
Tunable Laser	MAP Tunable Laser

Polarization Mode Dispersion - Jones Matrix Method

Devices - Fiber, isolators, circulators, Dense Wavelength Division Multiplexer (DWDM) devices

Introduction - Polarization Mode Dispersion (PMD) is the variation in delay with polarization state. This leads to pulse broadening. For systems such as OC-192 and OC-768, PMD results in eye closure. The main source of PMD is the transmission fiber. The best fibers have PMD of 0.08 ps/km½ while older fibers may have 1 ps/km½ or more. Other sources of PMD include the isolators and Erbium-doped fiber used in amplifiers.



Measurement Method - The Jones matrix method measures the change in 3 known polarization states launched into the Device Under Test (DUT) as the wavelength is changed. The change in polarization state is measured with a polarimeter. Since the wavelength step size is small this measurement can be used with devices having a narrow passband. A key issue for this type of measurement is the required step size. The step size is related to the amount of PMD.

Standards

EIA Fiber Optic Test Procedures EIA-455-122, "PMD measurement for singlemode optical fibers by the Jones matrix eigenanalysis."

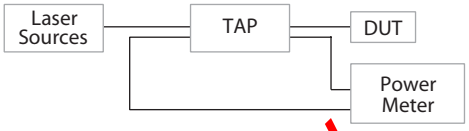
Product Reference - Complete solutions are available for measuring chromatic dispersion or a set-up can be built from individual parts. The complete solution is available in the Swept Wavelength System (SWS) system. The parts required for a modular approach are shown below.

Polarization Controller	MAP Polarization Controller
Polarimeter	external vendor
Tunable Laser	MAP Tunable Laser

Return Loss

Devices - Passive components

Introduction - Return Loss (RL) or reflectance is the ratio of the reflected power to the incident power. The return loss must be measured at all the wavelengths the device will be exposed to. Poor return loss can lead to unstable interferometric cavities. The most common example is a poorly mated connector.



Measurement Method - The test set is calibrated by measuring the tap ratio between the Device Under Test (DUT) and the power meter. The amount of scattered light is then determined by measuring the reflected light when the fiber to the DUT is terminated. The return loss is then measured by comparing the ratio of the power incident on the DUT with the reflected power. Special care must be taken in the test set to make sure there are no reflections from the tap output connections to the power meter.

Standards

TIA 455-107 FOTP-107 Determination of component reflectance or link/system return loss using a loss test set

IEC 60300-3-6: Fibre optic interconnecting devices and passive components -Basic test and measurement procedures - Part 3-6: Examinations and measurements - RL

IEC 61300-3-7: Fibre optic interconnecting devices and passive components - Basic test and measurement procedures - Part 3-7: Examinations and measurements - Wavelength dependence of attenuation and return loss

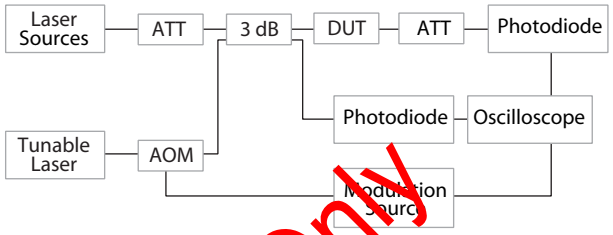
Product References - Complete solutions for return loss are available such as the JDS Uniphase Backreflection and Multichannel Backreflection Meter (RM or RX Series). Depending on the number of wavelengths, the test set can also be built from discrete parts. The parts required for a modular approach are shown below.

Laser or Tunable Laser	MAP DFB Laser
Tap 3 dB Coupler 4-port	MAP Utility
Power Meter	MAP Power Meter

Transient Response

Devices - Erbium-Doped Fiber Amplifiers (EDFAs)

Introduction - In Dense Wavelength Division Multiplexing (DWDM) systems wavelengths can be added or dropped at any time. This creates a transient pulse in the EDFA. This pulse can propagate in a chain of amplifiers and damage optical components.



Measurement Method - The test consists of turning on or off the desired wavelength channel or channels and measuring the change in output power. The test set contains a set of laser sources that simulate the system operation. The block diagram shows a tunable source that is modulated by an Acousto-Optic Modulator (AOM). The output of the amplifier goes to a photodiode. The attenuator (ATT) ensures that the diode is not saturated.

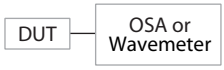
Product References - This test is usually built from a discreet set of instruments. The parts required for a modular approach are shown below.

Laser or Tunable Laser	MAP DFB Laser
Tap 3 dB Coupler 4-port	MAP Utility
Photodiodes	JDS Uniphase
Oscilloscope	external vendor
Attenuators	MAP Precision Attenuator

Wavelength

Devices - Lasers

Introduction - The absolute wavelength is an important parameter for the design and operation of Dense Wavelength Division Multiplexer (DWDM) systems. The wavelength is typically measured using an Optical Spectrum Analyzer (OSA) or wavemeter. The OSA is a grating based instrument while the wavemeter is based on a Michelson interferometer.



Measurement Method - For the OSA the wavelength is measured by taking a scan at the wavelength of interest. If the unit is properly calibrated the peak wavelength and side mode suppression ration can be obtained. The resolution of the OSA will limit the accuracy of the measurement. For higher resolution (<10 pm) a wavemeter is used. Care should be taken to make sure the settings provide information on all side modes. One issue with the measurement is what environment is the wavelength specified. Most units will give the wavelength in vacuum. The difference between vacuum and air is about 0.4 nm.

Product References - Wavemeters and OSAs are usually purchased as a complete solution.

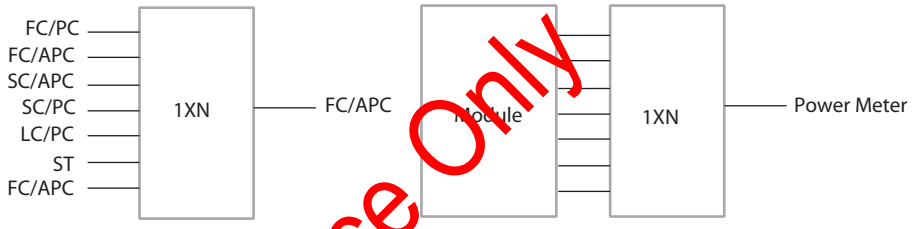
OSA external vendor

Wavemeter external vendor

Switch Application - 1 x N Switches

Introduction - Most optical test systems have multiple inputs and outputs. It is necessary to route the light from many combinations of inputs and outputs. This task can be accomplished through the use of 1 X N switches designed for Instrumentation. These switches have 0.4 dB typical loss and repeatability of ± 0.01 dB.

Switch Application - The figure below shows a few applications of 1 X N switches. In the first application, the switch provides a way to select the correct connector type for measurements. This is a common situation for testing modules. The second application shows the ability to select multiple outputs of a module for connection to a power meter.

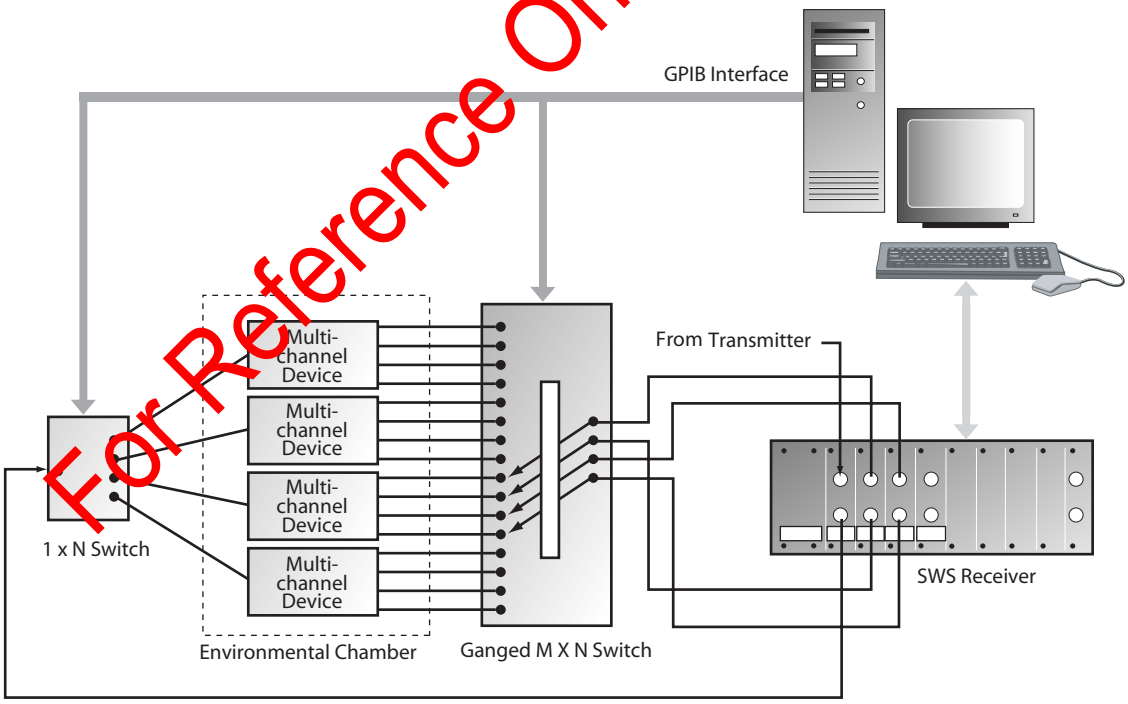


Product References - 1 X N switches are available in both the MAP platform and as stand-alone units.

Switch Application - Environmental Testing

Introduction - A common task in the development of a new device is environmental testing. The reliability documents define a series of temperature tests that must be done on multiple devices. Typically, the device performance must be monitored in almost real time. The JDS Uniphase Swept Wavelength System (SWS) is well suited for this type of testing. It provides measurements of Insertion Loss (IL), as a function of wavelength.

Switch Application - In the example shown below, a combination of switches is used to test multiple devices that each have multiple outputs, such as an AWG demultiplexer. In the configuration below, the output from the SWS control module is connected to a 1 X N switch. The output of this switch is connected to the input of each device. The output of the device is connected to a detector channel input of the SWS receiver. The switch can step through each device and output. The use of an M X N ganged switch and the multiple detection channels of the SWS decrease measurement time.

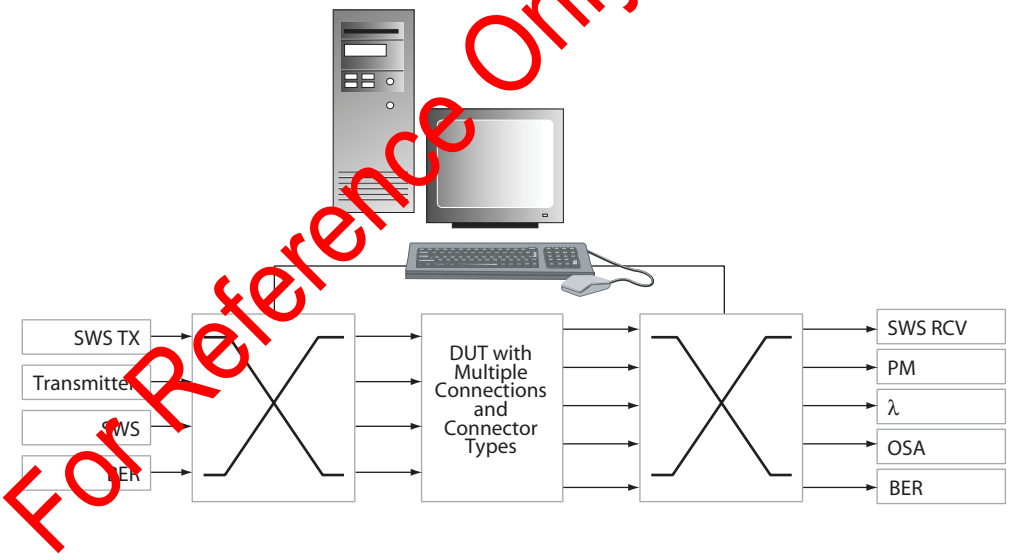


Product References - 1 X N switches are available in both the MAP platform and as stand-alone units. A software package for environmental testing based on the SWS is also available.

Switch Application - Multiple Application Testing

Introduction - It may be necessary to perform multiple tests on a single device. In addition, most systems have multiple devices that need to be tested. Performing these tests can require a major investment in both time and capital. One of the most time consuming and possibly damaging activities is connecting the device to the test set. Connectors may become damaged during multiple reconnections, if proper cleaning procedures are not followed.

Switch Application - M X N non-blocking cross connect switches can be used to reduce measurement and reconnection time. These switches allow any input to be connected to any output. Thus, multiple devices can be tested simultaneously without the need to reconnect. Multiple short duration tests may be run on one device while a longer measurement, such as Bit Error Rate (BER), is performed on another device.



Product References - Cross-connect switches are usually custom-designed to the application based on JDS Uniphase SG Series Programmable Matrix Switches.

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